



**W-6 UPPER SEGMENT: HWY 90 TO SW MILITARY DRIVE SEWER MAIN PROJECT**  
**Solicitation Number: CO-00317**  
**Job No.: 19-4519**

**ADDENDUM 4**  
**March 20, 2020**

To Respondent of Record:

This addendum, applicable to work referenced above, is an amendment to the price proposal, plans and specifications and as such will be a part of and included in the Contract Documents. Acknowledge receipt of this addendum by entering the Addendum number and issue date on the space provided in submitted copies of the price proposal.

<b>RESPONSES TO QUESTIONS</b>
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**Q1:** If there is an extension to the proposal due date, we request an extension to the RFI deadline currently set at March 23rd. The current date gives Responders only one business day after the pre-bid and core viewing to submit their final questions.

**Response:** *Refer to Addendum No 2, posted 3/13/20.*

**Q2:** The Table of Contents for the Contract Documents lists the SAWS Specifications for Water and Sewer Construction (October 2019) as part of their "Separate Documents". The Business Center found on the SAWS website only houses the SAWS Construction Specifications that were updated on March 3, 2017. Please advise where Bidding Contractors can find the October 2019 version.

**Response:** *Contractor is directed to use the Construction Specifications updated on March 3, 2017. Construction specifications can be found on the SAWS website found at the following link: [https://apps.saws.org/business\\_center/specs/constspecs/](https://apps.saws.org/business_center/specs/constspecs/) Table of Contents has been updated accordingly. Reference the Changes to Specifications Item 1 in this Addendum.*

**Q3:** Is there existing CCTV footage that showcases the existing condition of the section to be sliplined at the Shaft #1 location?

**Response:** *Yes. This footage will be provided. Reference the Changes to Specifications Item 7 in this Addendum.*

**Q4:** Sheet C83A, Note #2, states "Meter vault physical dimensions and design shown on C85A." However, Sheet C85A only contains details for Temporary Chain Link Wire Fence and Concrete COSA Trail Typical Section. Where are the dimensions and design for the vault?

**Response:** *Vault dimensions can be found on Sheet 86A. Reference the Changes to Plans Item 11 in this Addendum.*

**Q5:** Are Proposers required to advertise their solicitation to sub/supplier bids in any local newspaper adverts? This is typical of industry standard good faith efforts and not mentioned in any of the contract documents.

**Response:** SAWS does not prescribe how to advertise to subcontractors and suppliers. However, direct contact (email and telephone), meetings, and advertisement in online or newspaper publications, online industry postings, social media outreach, and membership-based organization outreach are the most common methods of Good Faith Effort outreach that prime contractors employ.

**Q6:** Proposers are directed to "List ALL Subcontractors/suppliers that will be utilized on this project/contract." Is this referencing the Key Subcontractors that will be included in our qualification package?

**Response:** All subcontractors and suppliers that are listed in your organizational chart need to be listed in the Good Faith Effort Plan. SAWS has the ability to track payments made to second and third-tier subcontractors and suppliers, and therefore, we want to know about all subcontractors and suppliers that your firm will be using on the project.

**Q7:** Supplemental Conditions, Section SC13 requires the contractor to allow access to and coordinate work with another SAWS Contract, W-1 Leon Creek: HWY 151 to HWY 90 Lower Segment Project (W-1). Please provide documentation for this project, items to be coordinated, and any contact information for Contractor performing the work.

**Response:** The W-1 Leon Creek: Hwy 151 to Hwy 90 - Lower Segment Project construction is ongoing. The estimation completion date for this work is 5/18/2021. As provided on Sheet G32 in Plans, access to the overlapping construction area will not be permitted until W-1 Lower Segment construction is complete. Coordination with the W-1 Lower Segment Contractor will occur via the SAWS W-6 Staff throughout construction.

**Q8:** The Supplemental Conditions amended Section 5.18 of the General Conditions to allow tunneling operations to work Monday through Sunday, 24-hours per day. In General Conditions, Article VIII, Paragraph 8.3 states "Work on Sundays or SAWS Designated Holidays will not be permitted except in cases of extreme emergency, and then only with the written permission of the Owner. If Sunday or SAWS Designated Holiday Work is permitted, the COI's average salary costs at time and one half will be charged to the Contractor." Will the contractor be charged for the COI time during tunneling operations on Sundays and Holidays? If so, please provide the rates at which the Contractor will be charged.

**Response:** Work will be permitted Monday through Sunday, 24-hours per day without being charged for COI costs. Reference the Changes to Specifications Item 6 in this Addendum.

**Q9:** In section 2.a.iii. of the Evaluation Criteria Form, respondents are instructed to list all current and recently completed 2-pass tunnels with 54-inch or larger carrier pipe installed via Tunnel Boring Machine (TBM) using the tables provided. There are 5 tables provided for this information. Should respondents provide information on only the 5 most recent tunneling projects in the past five years, or replicate the tables for each of their additional projects that took place in the past 5 years?

**Response:** Replicate the tables as needed for additional current and recently completed 2-pass tunnels with 54-inch or larger carrier pipe installed via Tunnel Boring Machine (TBM) that took place in the last 5 years.

**Q10:** In the Supplementary Instructions to Respondents, Section F. 2., and again in the first line of the Evaluation Criteria Form, it is indicated there is a page limit, but it is not clear what the page limit is. Will SAWS please clarify if there is a page limit for each proposal envelope, and if so, what is the page limit for each envelope?

**Response:** Please see the Required Document Matrix posted on the SAWS website, which assists in determining the page count.

**Q11:** May the 1-page organizational chart required for Evaluation Criteria Section 1.a.vii. be printed on an 11x17" page?

**Response:** Yes.

**Q12:** Regarding the 20% M/W/SBE participation goals set for the project, the following items are not available to contract to M/W/SBE's and make up a third of the Engineers Estimate. The bid item for Hobas Pipe (#66) for \$18,098,685 is controlled by SAWS. The (3) Allowance bid items (#112, 113, & 114) worth \$8,350,000 are speculative and assigning firms to perform portions of this work is not possible prior to the allowance being initiated by SAWS. The (2) required TBM's worth between \$25-30 million are highly engineered and proprietary, only offered by direct purchase from the manufactures therefore they are not eligible for M/WBE participation. We therefore request that the calculation of the 20% overall participation goals be revised to the actual dollar amount available to contract to M/W/SBE at the time of bid. A more applicable contractible project amount would be 20% of \$105-110m or 13% of the total engineers estimate.

**Response:** *Thank you for bringing this to our attention. You are correct, and the request is reasonable. According to the total costs for bid item #66 for Hobas Pipe; the (3) Allowance bid items (#112, 113, & 114); and the cost of a Tunnel Boring Machine (upwards of \$30 million); it has been determined that there is no SMWVB availability for approximately \$56 Million of the W-6 project. Therefore, SAWS clarifies that the 20% annual aspirational SMWB goal applies to \$106 Million, which is (more) applicable for SMWB availability. The goal excludes the items mentioned above: Bid Items 66, 112, 113, 114, and the cost of a Tunnel Boring Machine.*

**Q13:** Is this mandatory pre-proposal meeting is still taking place next Wednesday?

**Response:** *No, the meeting is now non-mandatory. The pre-proposal meeting took place as scheduled. An option to attend by WebEx was included. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20. Refer to SAWS website for a recording of the pre-proposal meeting.*

**Q14:** Mapei is not a contract. We are a vendor providing chemicals for soil stabilization and grout. Are vendors required to attend?

**Response:** *No. Vendors are not required to attend.*

**Q15:** We understand that SAWS is working to accommodate multiple requests for a revised bid date and understand the time constraint SAWS is faced with regarding the project overall. However, we would just like to stress the importance of that extension to May 8, 2020. Beside the reasons stated before, our Joint Venture is currently working through complications with imposed restricted travel regarding the current Coronavirus event. This is causing multiple issues with coordinating travel and arranging efficient meetings to put the estimate and RFCSP together collaboratively. We are also facing challenges with our current SMWB outreach event due to this issue. We hope that SAWS can adjust this bid date to accommodate and understands that they level of effort to put together responsible estimate and proposal is quite high. We certainly would like to bid this project and hope that we will be able to based on a revised bid date.

**Response:** *The proposal due date has been extended to May 1, 2020. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20.*

**Q16:** In light of recent World events and company travel restrictions due to the Coronavirus, will SAWS consider offering the mandatory pre-bid meeting by way of a webinar or other remote meeting application for folks that are effected by travel restrictions?

**Response:** *Yes. An option to attend by WebEx was included. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20. Refer to SAWS website for a recording of the pre-proposal meeting.*

**Q17:** SIR-4 - Item ix. states: "Provide a financial statement prepared within the last twelve (12) months by an independent Certified Public Accountant." Last sub-bullet states "If respondent is organized as a corporation, partnership, LLP, LLC or joint venture, submit complete financial statements, including a Balance Sheet, Income Statement and Statement of Cash Flows, prepared in accordance with generally accepted accounting principles, for the current fiscal year-to-date, and the most recent three complete fiscal years."

**Question:** Our company does not prepare partial "current fiscal year-to-date" financial statements. Furthermore, we expect to have audited 2019 financial statement available by the bid date. Please delete the requirement for "current fiscal year-to-date" financial statement.

**Response:** *SIR-4 Item ix has been revised. Reference the Changes to Specifications Item 2 in this Addendum.*

**Q18:** SIR-5, Item c.iii. Asks the respondent to "List any fatalities in the safety history of the Prime Contractor and Key Subcontractors."

**Question:** Given our company history dates back to the 1920's, we do not have access to complete records for our "history". Please provide a period of years for the proposer's response (e.g., 10 years).

**Response:** *Please use a period of 10 years. Reference Changes to Specifications Item 3 in this Addendum.*

**Q19:** SIR-6, Item 2.a.i. states "List and describe three (3) completed projects within the last ten (10) years of similar size, scope, and complexity to the work described in the Contract Documents for this Project."

**Question:** Our JV offers a wider variety of experience. Does the Response Format allow for us to submit three (3) projects for each company that makes up our JV?"

**Response:** *A response to the above question will be provided in a later addendum.*

**Q20:** SIR-6, Item 2.a.ii. states "A minimum of two (2) of the three (3) projects listed above must have been performed by proposed Key Personnel (Project Manager, Project Engineer, Lead Surveyor, Quality Assurance and Quality Control Lead, Project Scheduler, Project Superintendent, Tunneling Superintendent(s), Tunnel Boring Machine (TBM) Operators, and Safety Manager) for this Project."

**Question:** It will be extremely challenging and in some cases impossible to include 9+ Key Personnel that worked on 2 out of 3 projects within the last ten (10) years that are similar size, scope, and complexity to this project. For newly formed JV's with a mix of Key Personnel from each JV partner, this would certainly be impossible. Please limit the Key Personnel positions to only the most critical positions to have had experience on these projects.

**Response:** *A response to the above question will be provided in a later addendum.*

**Q21:** SIR-3, Item 1.a.vii. states "Provide a 1-page organizational chart that describes the composition of the team for this project. The chart shall include proposed Key Personnel for the Prime Contractor and Key Subcontractor(s)." SIR-7, Item 2.b.i. states "Provide a list of two (2) projects that the identified Key Subcontractors' Project Manager and/or Project Superintendent(s) participated in that were of similar size, scope, and complexity to the work described in the Contract Documents that have been completed in the last ten (10) years."

**Question:** These statements imply that there are Key Personnel, specifically Project Manager and/or Project Superintendent(s) required for Key Subcontractors, however I cannot find a requirement for the Key Subcontractors' Key Personnel separate from the overall Key Personnel positions identified on page SIR-3, Item D.4. Please advise.

- Response:** *The intent is for the Respondent to demonstrate the experience of the Key Personnel identified. Key Personnel, as identified in the Definition section of the SIR, can be from a Key Subcontractor or from the GC depending on the Respondent's team organization and the roles of Key Subcontractors.*
- Q22:** ECF-1, 3rd sentence states "While there are page limits for this solicitation, there are no character limitations."
- Question:** I cannot find any reference or requirement indicating page limits for this proposal. Please confirm that there are not any page limits.
- Response:** *See response to question No. 10 in this Addendum.*
- Q23:** G6, Bid Item 55 is described as EXTRA DEPTH (>6') FIBERGLASS MANHOLE, MITER (4' DIAMETER). However in Bid Item Tables Displayed on the drawings these same items are described as EXTRA DEPTH MANHOLE (>6') (4' DIAMETER).
- Question:** Can you please confirm our current assumption that these two descriptions are representative of the same Bid Item for a total quantity 135 VF is correct?
- Response:** *Bid item 55 has been revised to remove "miter" from the language. Reference the Changes to Plans Item 2 and Item 7 in this Addendum.*
- Q24:** G6, Bid Item 33 is described as CONSTRUCTION PERIMETER FENCE (COSA SPEC) with an estimated quantity of 13,850 LF. However after analyzing the contract drawings we could not find this bid item listed.
- Question:** Could you please provide clarification on where this bid item is located within the project drawings?
- Response:** *Proposed temporary construction perimeter fence locations can be found on Contractor Access and Staging Plans, Sheets G30 through G33.*
- Q25:** SHAFT BASE PAD PREPARATION. Item A. "The excavation limits shall extend a minimum of 2 feet beyond the edges of the proposed foundation.
- Question:** The Foundation Slab shown on Sheet S21 is 25 feet in diameter, this would mean that the minimum shaft excavation would have to be 29 feet in diameter. Table 1. on Sheet TU-20 has an inside diameter for this shaft of 25 feet in diameter. Can you confirm which governs.
- Response:** *The note on sheet S1 requiring excavation beyond the edges of foundation slabs has been removed, allowing for the ~25' construction shaft diameter noted elsewhere in the plans. Reference Changes to the Plans Item 14 in this Addendum.*
- Q26:** **Question:** Please provide the missing structural details for Shaft #1 (W-6 Middle Connection)
- Response:** *The "Shaft" at W-6 Middle Connection refers to the Construction Shaft. The permanent structure is a Tee-Base Manhole. Drawings that clarify this have been included as part of this Addendum. Reference Changes to the Plans Item 13 in this Addendum*
- Q27:** **Question:** Due to the complex nature of the bid proposal structure and the significant scope of the project, we are requesting that the proposal submittal date be extended by 4 weeks to May 8, 2020. The additional time will allow Contractors to submit a more detailed and responsive proposal
- Response:** *The proposal due date has been extended to May 1, 2020. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20.*

- Q28:** Due to the unprecedented situation regarding COVID-19, many companies, including ours, are imposing travel restrictions for employees. Would SAWS consider holding the mandatory Pre-Proposal Meeting on March 18<sup>th</sup> remotely?
- Response:** Yes. *An option to attend by WebEx was included. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20. Refer to SAWS website for a recording of the pre-proposal meeting.*
- Q29:** To properly plan for coordination between the W-6 and W-1 projects, would the Owner consider providing a baseline schedule of the W-1 project's planned activities at the W-1 Connection Shaft location?
- Response:** *See response to question No. 7 in this Addendum.*
- Q30:** Some cellular grouting firms require specific grout port sizing and placement along the alignment to fit with their specialized equipment, which brings forth several questions regarding the HOBAS pipe. Could the 1" grout ports be increased to 2" if needed? As long as the maximum distance between grout ports is not increased, could additional grout ports be added if required? Because the pipe Purchase Order has been pre-negotiated, is it even possible to add grout ports? If so, who is responsible for this cost, and if the Contractor, then where should this cost be included in the Price Proposal?
- Response:** *If Contractor wishes to propose an alternate grout port arrangement, they may do so provided the arrangement meets project performance intent. Contractor is responsible for any additional cost beyond what is outlined in the Contract Documents and the submittal of materials provided in the HOBAS submittal. It is up to the Contractor regarding where the cost is included, however "Installation of Pipe in Tunnel", or "Annular Backfill for Carrier Pipe" seem like logical choices.*
- Q31:** SC18 mentions that the cost or lost production time associated with lowering or raising of cranes at Shafts #1 and #7 to be incidental to the tunneling cost. Does this apply solely to inclement weather and the predetermined air shows mentioned in SC7, or will the FAA and/or Kelly Field be directing the crane operators to boom down at any given time? If it is the latter, could the Owner baseline the potential number and duration of unplanned interruptions so it can be included in the tunneling cost?
- Response:** *The FAA has stipulated that they may require cranes to be lowered during inclement weather, not at "any given time". Baseline rain days and unusual weather events are outlined in the General Conditions, Article VIII, Paragraph 8.5.*
- Q32:** Will the Contractor need to acquire the FAA permits mentioned in SC18, or will these be acquired by SAWS?
- Response:** *FAA permit has been acquired by SAWS.*
- Q33:** The Construction Sequencing table in Special Specification Section 01030 mentions the "Wetmore Road 24-inch Stubout" and lists Sheet C38A as reference. This plan sheet does not exist. Please advise.
- Response:** *This item has been deleted. Reference Changes to the Specifications Item 8 in this Addendum.*
- Q34:** Plan Sheet G36 lists 970 SY of ONE COURSE SURFACE TREATMENT (TXDOT SPEC), HOT MIX ASPHALTIC PAVEMENT - TYPE D (4' COMPACTED DEPTH)(TXDOT SPEC), and SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (4" DEPTH) (TXDOT SPEC). However, the callouts on the sheet only show 870 SY of each. Please advise.
- Response:** *Quantities have been revised. Reference to Change in Plans Item 3 in this Addendum. The Price Proposal will be updated to reflect the revised quantities in a later addendum.*

- Q35:** Note 4 on Bid Drawing G38 indicates that the Contractor is to determine the flow rates in sewers with a diameter of 24" and under. Please provide a baseline for these flow rates so that Contractor can design an adequate bypass system?
- Response:** *Contractor to use full pipe flow as baseline for flow rates.*
- Q36:** Please clarify the intent of SC3. Consequential Damages. Are liquidated damages and stipulated penalties considered Consequential Damages and considered as part of the not-to-exceed of \$18 million?
- Response:** *Liquidated Damages are separate and apart from Consequential Damages.*
- Q37:** In reference to Supplemental Conditions Section 5.18 Working Hours, please clarify the definition of "tunneling operations". Does this also include pipe installation and grouting of annulus? It is assumed that all shaft excavation operations will be required to follow the working hours of 8am to 5pm.
- Response:** *All construction activities are permitted Monday-Sunday, 24 hours per day, with the exception of several specific exclusions that are outlined in the Special Conditions, notably SC12., SC18., and SC7.*
- Q38:** Can the organizational chart be printed on 11"x17" paper?
- Response:** *Yes*
- Q39:** On SIR-13, it is stated that certain documents "will not count as printed pages" and on ECF-1, "page limits" are referenced. With the expectation of the resumes being limited to one page, there are no other mention of page limits for the various sections. Please advise.
- Response:** *See response to question No. 10 in this Addendum.*
- Q40:** On ECF-1, it states: "The intent of this document is to provide Respondents a structure for their responses. While there are page limits for this solicitation, there are no character limitations. Respondents should provide answers to the questions below in the order and spaces provided to ensure continuity between Respondent's submissions. When responding to the questions below, Respondents should use the space provided in this form, unless otherwise indicated." Since the Owner has provided a MS Word format document for the Evaluation Criteria Forms, what space or page limit criteria apply? Please note that to answer some of the questions to the level of detail requested will take considerably more room than what is provided on each of the pages. In lieu of responding to the questions on the ECF pages, would the Owner accept references to attachments, which are attached and included after the ECF pages?
- Response:** *See response to question No. 10 in this Addendum.*
- Q41:** SC10.A of the Special Conditions and Section 5.3.7 of the Supplemental Conditions both refer the bidder to a Floodplain Development Permit. Please provide a copy of this permit.
- Response:** *A copy of this permit is attached to this Addendum.*
- Q42:** The Price Proposal items 32 (TEMPORARY EROSION, SEDIMENT, AND WATER POLLUTION PREVENTION AND CONTROL (COSA SPEC)) and 37 (STORM WATER POLLUTION PREVENTION PLAN) seem to encompass the same scope of work. For example, Notes 8 and 9 on plan page EC11 direct the Contractor to include costs for erosion control items and site restoration seeding in the "SWP3 Lump Sum." If cost for erosion control items is to be included in Price Proposal Item 37, what cost is to be included in Item 32?

**Response:** *These quantities were redundant. Plans and other documents have been revised to remove Item 37. Reference to the Plans Item 2 in this Addendum. The Price Proposal will be updated to reflect the revised quantities in a later addendum.*

**Q43:** On RQ-1 it states "(NOTE: Co-Respondents are two or more entities proposing as a team or joint venture with each signing the Agreement, if awarded. Sub-contractors are not Co-Respondents and should not be identified here. If this submittal includes Co-Respondents, provide the required information in this Item #1 for each Co-Respondent by copying and inserting an additional block(s) before Item #2.)"

**Response:** *See Response to question No. 44 & 45 in this addendum.*

**Q44:** If only a single Authorized representative of a Joint Venture is signing the Agreement, will Section one need to be filled out for both Joint Venture Partners? Keeping in mind the "Respondent Name" as it will appear on the Agreement will be the name of the Joint Venture. Also, Joint Ventures typically do not have FEI Numbers at the time of bid.

**Response:** *If the respondent is a Joint Venture, only the managing member should complete Section 1.*

**Q45:** Can the Owner please provide this Respondent Questionnaire in an editable Format (i.e., MS Word), so additional blocks can be inserted as required.

**Response:** *Yes, SAWS will post on the SAWS website. However, as a reminder, the form shall not be modified in any way or the Respondent may be found non-responsive.*

**Q46:** On the Good Faith Effort Plan for Construction SUBCONTRACTS form, it states to "List ALL SUBCONTRACTORS/SUPPLIERS that will be utilized on this project/contract. (SNWVB and Non-SMWVB)". With no minimum limit, this list could be very long and at the time of bid, not all Subcontractors and Suppliers for very small items are known. Would the Owner consider establishing a minimum contract price that would be required to be listed? –

**Response:** *Please list as many subcontractors and suppliers as possible. We welcome long lists of subcontractors and suppliers that inform us (in detail) who will be working and providing products for the project, so that subcontractor and supplier payment tracking (in the SAWS Subcontractor Payment & Utilization Reporting "SPUR" System) can be as accurate as possible, for security background check procedures, and because the SPUR System syncs with our wage and hour monitoring system, LCPtracker. If your firm is awarded a contract, you may also add subcontractors and suppliers through the duration of the project. You may attach a spreadsheet immediately behind the first page of the Good Faith Effort Plan that lists all of your subcontractors and suppliers at the time of the bid due date. However, the spreadsheet must have the following data headers:*

Legal Name of Subcontractor/Supplier (including "doing business as", if applicable)	Address of Office Location to Perform Project Work or Provide Supplies. (Only Local firms will be counted for SMWVB credit):	Scope of Work/Supplies to be Performed/Provided by Firm:	Estimated Contract (dollar) Amount on this Project:	Certification Type & Agency. (Only SCTRCA or HUB certifications are recognized):
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**Q47:** Page 2 of the GFE states that "Copies of said notices must be provided to the SMWVB Program Manager at the time the response is due." Does this mean that all this Good Faith backup documentation is required to be submittal the time of the bid/proposal date? If the detailed plan is to be submitted by Contractor as a part of the Proposal on bid day, we respectfully request that the GFE documentation be allowed to be submitted three(3) business days after bid opening. This is due to the extensive amount of reporting and back-up documentation needed to go into these GFE documentation, and the often last-minute nature of subcontractor and supplier quote receipt.

**Response:** *Our standard procedure is to collect all Good Faith Effort Plan information at the time that the response is due. We will adhere to our standard, because this project has been advertised*



*substantially longer than most other SAWS construction projects (35 business days vs. 10 business days). Please note that Section C. 1. of the Good Faith Effort Plan states, "Notices to firms contacted by the proposer for specific scopes of work identified for subcontracting/supply opportunities must be provided to subcontractor/supplier **not less than five (5) business days prior to bid/proposal due date.**"*

**Q48:** If the Conflict of Interest Questionnaire is NOT applicable to the Contractor, is the Form to be submitted blank? Should the Contractor submit this Conflict of Interest Form for any Subcontractors or Suppliers whom the Contractor plans to utilize for the project?

**Response:** *The Conflict of Interest Questionnaire (CIQ) is a required document. The form should be submitted, signed and dated signed. The CIQ is only required by the Prime Contractor, not subcontractors.*

**Q49:** Regarding the Evaluation Criteria Form on ECF-1, Should questions 1.a.i thru 1.a.v be answered for the Joint Venture or for the individual companies which make up the Joint Venture?

**Response:** *If the respondent is a Joint Venture, only the managing member should complete Section 1.*

**Q50:** Supplementary Instructions to Respondents, section E.5.b. (on page SIR-11) states that "All firms submitted as SMWVB must provide a copy of their certification certificate." Are certificates to be submitted with the proposals or provided upon request at a later time?

**Response:** *The SMWVB Program Manager will access the South Central Texas Regional Certifications Agency's (SCTRCA) database to verify certification status of Respondent and their subcontractors. Reference Changes to Specifications Item 4 in this Addendum.*

**Q51:** Sheet C84 refers to an item for "Annular Backfill for Carrier Pipe (24-inch Sanitary Sewer) in a quantity of 167 LF. This item does not exist on the Price Proposal. Is this cost to be included in Item 103? Please advise.

**Response:** *Price is subsidiary to Item 103, sheet C84 has been revised to reflect this change. Reference Changes to the Plans Item 9 in this Addendum. The Price Proposal will be updated to reflect the revised quantities in a later addendum.*

**Q52:** What is to be included in Price Proposal Item 111 - W-1 Cleaning and Maintenance? We are unable to find anything in the specifications regarding a scope or measurement and payment for this item.

**Response:** *The contractor shall reference Specification 01030 for the W-1 Cleaning and Maintenance which was added via this Addendum. Reference Changes to Specifications Item 8 in this Addendum. The Price Proposal will be updated to reflect the revised quantities in a later addendum.*

**Q53:** If the Respondent is a Joint Venture, is the W-9 to be submitted for the Joint Venture or can the individual members comprising of the Joint Venture submit their respective W-9 forms? Requiring to be submitted by the JV is not standard practice because typically the actual process of forming a Joint Venture Company and obtaining an FEI number doesn't happen unless the project is awarded to the JV.

**Response:** *If the respondent is a Joint Venture and does not have a FEI number, the individual members of the potential Joint Venture should submit their respective W-9 Forms.*

**Q54:** Can more than three (3) projects be submitted for to show similar project experience for the Prime Contractor?

**Response:** *No.*

**Q55:** Due to the size, complexity, and length (3-5 years) of typical tunnel projects, the probability of the same 9 Key Personnel working on two of the same three projects is very low. Additionally, many TBM operators are typically local union operators that have been trained by more experienced operators and therefore are typically different on every project. Also, this 2-of-3 project requirement essentially precludes the submission of a Key Personnel from a JV partner, since they likely won't have been involved in two of the three projects submitted. In order for Respondents to assemble the best and most qualified teams available, please consider removing or relaxing this requirement, or allowing more than three projects to be submitted.

**Response:** *See Response to question No. 54 in this addendum.*

**Q56:** The primary scope of this project is tunnel and shaft work, which is anticipated to be more than 40% of the value of work - the minimum required to be performed by the Prime Contractor. With that said, are two additional projects to be submitted for each tunneling, carrier pipe installation, and tunnel shaft installation if the experience has already been met with the three projects submitted to meet the qualifications of E.2.a.i?

**Response:** *Concerning SIR Section E.2.b.i, Contractors shall provide two (2) projects that identify Key Subcontractors (or the Prime Contractor's, per section ii) and put the best information forward to demonstrate their qualifications for the roles served.*

**Q57:** Is the Owner expecting that a unique individual be assigned to each of the Key Personnel positions, or can an individual perform the responsibilities of multiple Key Personnel positions identified to be submitted with the proposal? For example, we don't foresee a Scheduler as a full time role, could the Project Engineer or QA/QC Lead perform these responsibilities? It is understood that in the case of TBM Operators, multiple individuals will be required to be submitted to meet the Respondent's means and methods.

**Response:** *If the Respondent feels that utilizing a particular individual for more than one task is feasible, they are free to do so. The Respondent is to note that SAWS retains sole discretion regarding what is deemed the most attractive staffing arrangement. If the Key Personnel proposed appear over utilized it may have a negative impact on the Respondent's score.*

**Q58:** In the Curve Summary of the HOBAS Pipe Submittal, there are a few inconsistencies when compared to the plans. Curves #3, 9, 10, and 14 do not match the exact plan values. The Curve Summary also shows Curve #17 with a pipe size of 104", whereas in the plans it is 60". Additionally, Curves #16 and #18 seem to be missing from this summary. Please advise.

**Response:** *A response to the above question will be provided in a later addendum.*

**Q59:** In light of the all the cancellations and warnings about group gatherings due to the Covid-19 virus, are you still going forward with the pre bid meeting on March 18<sup>th</sup>? Many of us have to travel for the meeting.

**Response:** *Yes. An option to attend by WebEx was included. Refer to Addendum No 2, posted 3/13/20 and Addendum 3, posted 03/17/20. Refer to SAWS website for a recording of the pre-proposal meeting.*

## CHANGES TO SPECIFICATIONS

1. Revise the Table of Contents for the Contract Documents to remove the reference to the SAWS Specifications for Water & Sanitary Sewer Construction (October 2019) to the following:

SAWS Specifications for Water & Sanitary Sewer Construction (March 3, 2017)

2. Update SIR-4 and SIR-5, E., 1. a. ix., bullet 4 (Question 17)

Supplementary Instructions to Respondents, page SIR-4 and SIR-5, E., 1. A. ix., bullet 4 is amended to read:

“If Respondent is organized as a corporation, partnership, LLP, LLC or joint venture, submit complete financial statements, including a Balance Sheet, Income Statement and Statement of Cash Flows, prepared in accordance with generally accepted accounting principles, and the most recent three complete fiscal years. Footnote disclosures must accompany the submitted year to date financial statements. If available, financial statements audited or certified by an independent certified public accountant should be submitted; otherwise, a notarized statement certifying the accuracy of the financial information and signed by an officer of the proposing entity must accompany the financial information. If any entity has been in existence less than three (3) years, the information shall be provided for the period of existence.”

3. Remove and Replace Section E, 1. c. iii on pages SIR 5- and SIR-6 of the Supplementary Instructions to Respondents with the following:

List any fatalities in the company’s safety history for the Prime Contractor and Key Subcontractors within the last ten (10) years.

4. Delete the sentence in Section E, 5. b. on page SIR 11 of the Supplementary Instructions to Respondents in its entirety and all remaining sections remain and are re-lettered.
5. Remove and Replace the Exhibit “C” Security Procedures in its entirety with the document included in this Addendum. The revised document should be referenced by Respondents submitting a proposal for this project.
6. Revise the Supplemental Conditions as follows:

Remove General Condition Article VIII, Section 8.3 in its entirety and replace as follows:

8.3 Calendar Day Contract - Unless otherwise specifically provided in Supplement or Special Conditions to the Contract, all Contracts shall be Calendar Day Contracts and “Day” as used in the Contract Documents shall mean a calendar day which are days of 24 hours each from midnight to the next consecutive midnight.

7. Revise Special Conditions to include the additional language, as follows:

Add the following Paragraphs after SC. 23.

**SC. 24 EXISTING 54" MAIN AT MILITARY DRIVE CROSSING - VIDEO**

Video of the existing line, crossing Military Drive, near Shaft #1, is available for viewing by prospective Respondents and has been made available for informational purposes only. SAWS will require the execution of a SAWS disclaimer form by the Respondent, and once obtained by SAWS, will be provided a link to access the videos. The video disclaimer form (attached) should be submitted to Florinda Gonzales via email at [Florinda.Gonzales@saws.org](mailto:Florinda.Gonzales@saws.org).

8. Remove and Replace the following Specification Section, included in this Addendum. The revised document should be used by Respondents submitting a proposal for this project:
  - SS 01030 – Sequencing and Tie-ins

This specification was revised to remove the reference to Wetmore Road and add language associated with cleaning and maintaining the W-1 Connection.

9. Remove and Replace the following Specification Sections, included in this Addendum. The revised documents should be used by Respondents submitting a proposal for this project:
  - SS 01030 – Sequencing and Tie-ins
  - SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM)
  - SS 02421 – Precast Concrete Segmental Liner
  - SS 02441 – Secant Pile Walls
  - SS 11310 – Package Metering Manhole

Each of these specifications was revised to refer to City of San Antonio (CoSA) Item 300 – Concrete, in lieu of SS 03300 – Cast in Place Concrete, as was explained in Addendum No. 1. CoSA Standard Specifications for Construction (June 2008) can be found at <https://www.sanantonio.gov/PublicWorks/Current-Vendor-Resources/Standard-Specifications-and-Details>.

10. Revise the following Specification Section to Remove the language described below from the specifications. The revised language should be used by Respondents submitting a proposal for this project:

- SS 02431 – Annular Backfill for Carrier Pipe

Remove the following language from the last sentence of Section 02431.4.I.

“and fibreglassed over to provide a continuous smooth interior surface of the pipe.”

## CHANGES TO PLANS

1. Sheet G2 – SHEET INDEX (SHEET 1 OF 2) – Revise and replace sheet in its entirety
  - Replace sheet title “C86 SEWER GENERAL DETAILS (SHEET 1 OF 3)” with the following: “C86 SEWER GENERAL DETAILS (SHEET 1 OF 4)”.
  - Replace sheet title “C86A SEWER GENERAL DETAILS (SHEET 2 OF 3)” with the following: “C86A SEWER GENERAL DETAILS (SHEET 2 OF 4)”.
  - Replace sheet title “C86B SEWER GENERAL DETAILS (SHEET 3 OF 3)” with the following: “C86B SEWER GENERAL DETAILS (SHEET 3 OF 4)”.
  - Insert Sheet title “C86C SEWER GENERAL DETAILS (SHEET 4 OF 4)”
2. Sheet G6 - OVERALL QUANTITIES - Revise and replace sheet in its entirety.
  - Replace quantity for line item 17 – 300 One Course Surface Treatment (TxDOT Spec) “970” with the following: “870”
  - Replace quantity for line item 19 – 305 6002 Salvaging, Hauling, and Stockpiling Reclaimable Asphaltic Pavement (2” Depth) (TxDOT Spec) “1940” with the following: “870”
  - Replace quantity for line item 20 – 340 Hot Mix Asphaltic Pavement – Type D (4-inch Compacted Depth) (TxDOT Spec) “970” with the following: “870”
  - Remove item no. 37 “SWPP Storm Water Pollution Prevention Plan”
  - Revise line item numbers “38 through 59” with the following: “37 through 58”
  - Revise item no. 55 - “853A Extra Depth (>6’) Fiberglass Manhole, Miter (4’ Diameter)” with the following: “853A Extra Depth (>6’) Fiberglass Manhole (4’ Diameter)”
  - Add Item no. 59 “857 30-inch FRP (ASTM D-3262) (SN72) Sanitary Sewer Line (4’-6’ Depth)
  - Replace item no. 111 “W-1 Cleaning and Maintenance” with the following: “01030 W-1 Cleaning and Maintenance”.
3. Sheet G36 -Abandonment Plan (Sheet 3 of 4)- Revise and replace sheet in its entirety.
  - Replace quantity for line item 300 One Course Surface Treatment (TxDOT Spec) “970” with the following: “870”
  - Replace quantity for line item 305 6002 Salvaging, Hauling, and Stockpiling Reclaimable Asphaltic Pavement (2” Depth) (TxDOT Spec) “1940” with the following: “870”
  - Replace quantity for line item 340 Hot Mix Asphaltic Pavement – Type D (4-inch Compacted Depth) (TxDOT Spec) “970” with the following: “870”
4. Sheet C1 - 104-INCH SANITARY SEWER PLAN & PROFILE- Revise and replace sheet in its entirety.
  - Label in plan view for stubout for future odor control “Install 30” FRP Pipe stubout for future odor control” with the following: “Install 20.0 L.F. 30” FRP Pipe stubout for future odor control”.
  - Display in profile view of 30” FRP stubout.
  - Add line item no. 59 “857 30-inch FRP (ASTM D-3262) (SN72) Sanitary Sewer Line (4’-6’ Depth) 20” to the quantity box.
5. Sheet C49 - 104-INCH SANITARY SEWER PLAN & PROFILE- Revise and replace sheet in its entirety.
  - Label in plan view for stubout for future odor control “Install 30” FRP Pipe stubout for future odor control” with the following: “Install 20.0 L.F. 30” FRP Pipe stubout for future odor control”.
  - Display in profile view of 30” FRP stubout.

- Add line item no. 59 “857 30-inch FRP (ASTM D-3262) (SN72) Sanitary Sewer Line (4’-6’ Depth 20” to the quantity box.
6. Sheet C67 - 104-INCH SANITARY SEWER PLAN & PROFILE- Revise and replace sheet in its entirety.
    - Label in plan view for stubout for future odor control “Install 30” FRP Pipe stubout for future odor control” with the following: “Install 20.0 L.F. 30” FRP Pipe stubout for future odor control”.
    - Display in profile view of 30” FRP stubout.
    - Add line item no. 59 “857 30-inch FRP (ASTM D-3262) (SN72) Sanitary Sewer Line (4’-6’ Depth 20” to the quantity box.
  7. Sheet C83 – Sanitary Sewer Plan and Profile Line H and Line I
    - Replace line item “853A Extra Depth (>6’) Fiberglass Manhole, Miter (4’ Diameter)” with the following: “853A Extra Depth (>6’) Fiberglass Manhole (4’ Diameter)”.
  8. Sheet C83A – Flow Meter Electrical Plan
    - Replace construction Note 2 “Meter vault physical dimensions and design shown on C85A” with the following: “Meter vault physical dimensions and design shown on Sheet C86A”.
  9. Sheet C84 – 24-INCH SANITARY SEWER SLIPLINE- Revise and replace sheet in its entirety.
    - Label in plan view for stubout for future odor control “Existing JBSA fence to be temporarily relocated. See Sheet #####” with the following: “Existing JBSA fence to be temporarily relocated. See Sheet C84A”.
    - Remove line item “02430 Annular Backfill for Carrier Pipe (21-inch Sanitary Sewer)” from quantity box.
    - Replace line item “02610 Steel Casing – (42-inch)” with the following: “02610 Steel Casing – (48-inch) (0.625-inch thick)”.
    - Add line item “1100 Slip-lining Sanitary Sewers (Slipline 48” Steel Casing w/24”) (10’-14’ Depth)”.
    - Replace line item “1100 Slip-lining Sanitary Sewers (Slipline 54” Steel Casing w/24”) (10’-14’ Depth)” with the following: “1100 Slip-lining Sanitary Sewers (Slipline 54” Steel Casing w/48”) (10’-14’ Depth)”.
    - Remove line item “XXX Remove and Relocate JBSA Perimeter Fence”.
  10. Sheet C86 – Sewer General Details (Sheet 1 of 3)- Revise and replace sheet in its entirety.
    - Replace sheet title “C86 SEWER GENERAL DETAILS (SHEET 1 OF 3)” with the following: “C86 SEWER GENERAL DETAILS (SHEET 1 OF 4)”.
  11. Sheet C86A – Sewer General Details (Sheet 2 of 3)- Revise and replace sheet in its entirety.
    - Replace sheet title “C86A SEWER GENERAL DETAILS (SHEET 2 OF 3)” with the following: “C86A SEWER GENERAL DETAILS (SHEET 2 OF 4)”.
  12. Sheet C86B – Sewer General Details (Sheet 3 of 3)- Revise and replace sheet in its entirety.
    - Replace sheet title “C86B SEWER GENERAL DETAILS (SHEET 3 OF 3)” with the following: “C86B SEWER GENERAL DETAILS (SHEET 3 OF 4)”.
  13. Sheet C86C – Sewer General Details (Sheet 4 of 4)
    - Insert Sheet “C86C SEWER GENERAL DETAILS (SHEET 4 OF 4)”
  14. Sheet S1 – Structural Notes
    - Revise Notes under SHAFT BASE PAD PREPRATION section, Note A with the following: “A. Excavations shall be extended to a depth of 6 inches below the proposed bottom of base foundation slab for the shafts.”
  15. Sheet EC3 – Erosion Control W-6 Middle Connection (Sheet 3 of 12)
    - Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
    - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
      - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4’)
      - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)

- Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
  - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
  - Item 168 6001 (TxDOT Spec) – Vegetative Watering
  - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
16. Sheet EC4 – Erosion Control Slip Line (Sheet 4 of 12)
- Revise Note 7 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 8 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
17. Sheet EC5 – Erosion Control Pearsall (Sheet 5 of 12)
- Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
18. Sheet EC6 – Erosion Control Merry Oaks (Sheet 6 of 12)
- Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
19. Sheet EC7 – Erosion Control Water Tower (Sheet 7 of 12)
- Revise Note 7 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 8 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”

20. Sheet EC8 – Erosion Control Hotel (Sheet 8 of 12)
- Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
21. Sheet EC9 – Erosion Control W-1 Connection (Sheet 9 of 12)
- Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
22. Sheet EC10 – Erosion Control W-1 Connection (Sheet 10 of 12)
- Revise Note 8 with the following: “Erosion control items shall be NSPI and inclusive of Item SP540.”
  - Revise Note 9 with the following: “The following vegetative restoration items shall be NSPI and inclusive of Item SP540:
    - Item 160 6003 (TxDOT Spec) – Furnishing and Placing Topsoil (4”)
    - Item 164 6035 (TxDOT Spec) – Drill Seeding (Perm) (Rural) (Clay)
    - Item 164 6041 (TxDOT Spec) – Drill Seeding (Temp) (Warm)
    - Item 164 6043 (TxDOT Spec) – Drill Seeding (Temp) (Cool)
    - Item 168 6001 (TxDOT Spec) – Vegetative Watering
    - Item 169 6001 (TxDOT Spec) – Soil Retention Blankets (CL1) (TY A)”
23. Sheet EC11 – Erosion Control Line C Receiving Bore Pit (Sheet 11 of 12)
- Revise Note 8 with the following: “All costs associated with erosion control, including rock filter dams, construction exits, sediment control fencing, sandbags, and erosion control logs, will not be paid for directly, but will be subsidiary to Item SP540. See SW3P Narrative for full list of subsidiary items and governing specifications.”
  - Revise Note 9 with the following: “All costs associated with site restoration, including topsoil, drill seeding (permanent and temporary), vegetative watering, and soil retention blankets, will not be paid for directly, but will be subsidiary to Item SP540. See SW3P Narrative for full list of subsidiary items and governing specifications.”
24. Sheet EC12 – Erosion Control Line B Bore Pit (Sheet 12 of 12)
- Revise Note 8 with the following: “All costs associated with erosion control, including rock filter dams, construction exits, sediment control fencing, sandbags, and erosion control logs, will not be paid for directly, but will be subsidiary to Item SP540. See SW3P Narrative for full list of subsidiary items and governing specifications.”
  - Revise Note 9 with the following: “All costs associated with site restoration, including topsoil, drill seeding (permanent and temporary), vegetative watering, and soil retention blankets, will not be paid for directly, but will be subsidiary to Item SP540. See SW3P Narrative for full list of subsidiary items and governing specifications.”

**CLARIFICATIONS**

**END OF ADDENDUM 4**

This Addendum is 116 pages in its entirety, including attachments.

Attachments:

- Table of Contents (1 Page)
- Video Disclaimer Form (1 page)
- CoSA Flood Plain Development Permit (2 pages)
- SS 01030 – Sequencing and Tie-Ins (4 pages)
- SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM) (17 pages)
- SS 02415 – Trenchless Crossings by Guided Boring or Microtunneling (13 pages)
- SS 02416 – Trenchless Crossing Jacking and Receiving Pit (5 pages)
- SS 02421 – Precast Concrete Segmental Liner (20 pages)
- SS 02431 – Annular Backfill Carrier Pipe (8 pages)
- SS 02441 – Secant Pile Walls (8 pages)
- SS 11310 – Package Metering Manhole (7 pages)
- SAWS Updated Security Procedures (03-03-2020) (3 pages)
- Plan Sheets (G2, G6, G36, C1, C49, C67, C84, C86, C86A, C86B, & C86C)



Jeffrey A. Farnsworth  
Kimley-Horn and Associates, Inc.





**Contract Documents**  
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**VIDEO DISCLAIMER FORM**

The video being provided through the file transfer protocol (FTP) site is for the RFCSP – W-6 Upper Segment: Hwy 90 to SW Military Drive Sewer Main Project. The video is being made available for the sole purpose of providing background information that may assist Respondents in preparing their response to this RFCSP associated with the condition of the existing 54-inch sanitary sewer main crossing Military Drive at Leon Creek in close proximity to the W-6 Middle Segment Connection. SAWS makes no representations about the accuracy of this information and disclaims any responsibility for its use.

The FTP details will be provided upon return of this completed form to Florinda Gonzales, Interim Contract Administrator, via email to: [florinda.gonzales@saws.org](mailto:florinda.gonzales@saws.org)

\_\_\_\_\_  
Firm/Vendor Name

Prime Contractor?    Yes \_\_\_\_\_    No \_\_\_\_\_

\_\_\_\_\_  
Representative's Printed Name/Title

\_\_\_\_\_  
Signature

\_\_\_\_\_  
Typed/Printed Firm Name

Date: \_\_\_\_\_



# CITY OF SAN ANTONIO

## FLOOD PLAIN DEVELOPMENT PERMIT



Application Number 20-222 Date 2/28/2020 Permit Number 2020222

### 1. APPLICANT DATA (Owner)

Company Name San Antonio Water System (SAWS)  
 First Name Cristina MI \_\_\_\_\_ Last De La Garza  
 Address: Number 2800 Street U.S. Hwy 281 North City San Antonio  
 State TX Zip Code 78212 Phone (210) 233-3255

**THE ABOVE PERMITTEE HAS APPLIED FOR A FLOODPLAIN DEVELOPMENT PERMIT. THE APPLICATION HAS BEEN REVIEWED BY THE FLOOD PLAIN ADMINISTRATOR AND IT IS HIS DETERMINATION THAT THE PROPOSED DEVELOPMENT IS LOCATED WITHIN AN IDENTIFIED FLOOD PLAIN OF THE CITY OF SAN ANTONIO OR E.T.J.**

**THE FLOOD PLAIN ADMINISTRATOR HAS REVIEWED PLANS AND SPECIFICATIONS OF THE PROPOSED DEVELOPMENT FOR CONFORMANCE WITH THE FLOOD PLAIN ORDINANCE NO. 57969 OF THE CITY OF SAN ANTONIO, TEXAS.**

**YOU ARE HEREBY AUTHORIZED TO PROCEED WITH THE FOLLOWING PROPOSED CONSTRUCTION:**

### 2. TYPE OF PROPOSED DEVELOPMENT

Proposed use: Other\*

\*If non-residential or other selected complete the following:

Type of use proposed: New sanitary sewer main (SAWS W-6 Upper Segment: HWY 90 to SW Military, Job No. 19-4519)

Occupant Name San Antonio Water System (SAWS) Phone (210) 233-3255

### 3. DESCRIPTION OF CONSTRUCTION - NOTE: Applicant shall provide two sets of plans of the proposed construction or development.

Type: Other Other (Describe): New sewer main (60", 78", 104" diameters) with connections to existing SAWS infrastructure and maintenance access shafts

**ON THE FOLLOWING DESCRIBED PROPERTY:**

### 4. LOCATION

Subdivision N/A Number \_\_\_\_\_ Lot Number \_\_\_\_\_ Block \_\_\_\_\_ NCB \_\_\_\_\_ Tract \_\_\_\_\_

Location Description: WORK IN FEMA 100YR FLOODPLAIN (LEON CREEK): Work primarily U/S (north) side of Hwy 90 parallel to highway access road crossing Leon Creek floodplain: D/S connection vicinity of SW Military Drive crossing at Leon Creek

Cristina de la Garza

Permittee Print Name

Cristina de la Garza

Permittee Signature

3/4/20

Date

Jeremy C. [Signature]

RECOMMEND FOR APPROVAL

3/5/2020

Date

3/5/20

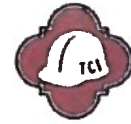
Date

FLOOD PLAIN ADMINISTRATOR (DIR. OF PUBLIC WORKS)

(Conditions and provisions on next page)



**CITY OF SAN ANTONIO  
FLOOD PLAIN DEVELOPMENT PERMIT**



**FOR OFFICE USE ONLY**

**Application Number** 20-222                      **Date** 2/28/2020                      **Permit** 2020222

**TO MAINTAIN COMPLIANCE WITH THE FLOOD PLAIN ORDINANCE REGULATIONS AND TO ELIMINATE OR MINIMIZE FLOOD DAMAGE POTENTIAL TO THE PROPOSED DEVELOPMENT, YOU ARE HEREBY DIRECTED TO CONSTRUCT YOUR PROPOSED DEVELOPMENT IN ACCORDANCE WITH THE FOLLOWING SPECIAL PROVISIONS:**

- For residential structures, the lowest floor (including basement) must be elevated to \_\_\_\_\_ feet mean sea level.
- For non-residential structures, the lowest floor (including basement) must be elevated or floodproofed to \_\_\_\_\_ feet mean sea level.
- Permittee must submit an elevation certificate from a registered professional engineer or surveyor that the finished floor level of each structure has been constructed at the specified elevation.
- For non-residential floodproofing, a registered professional engineer or architect must certify that the floodproofing methods are adequate to withstand the flood depths, pressures, velocities, impact and uplift forces and other factors associated with the base flood.

**Other provisions:**

- \* This Floodplain Development Permit (FPDP) is valid until JUNE 30, 2023 or until the completion of the project work, whichever occurs sooner. After JUNE 30, 2023 this permit will become null and void and a new permit will be required.
- \* If the work does not commence within 6 months from the date of this permit a new Floodplain Development Permit will be required.
- \* No material of any kind will be allowed to be deposited or stock piled overnight within the floodplain or drainage right-of-way without prior approval from staff in the COSA TCI Department's Floodplain Management group (telephone #: 210-206-8433).
- \* Within five (5) working days of a storm event: The property owner/contractor is responsible for both (1.) repairing any damage that may occur and (2.) removing any materials that may be deposited downstream of the subject site as a result of the proposed work.
- \* This FPDP is NOT a building permit and does not supersede the requirement for any additional local building permits or ROW permit. The contractor shall coordinate with the appropriate COSA department regarding applicable permit requirements.
- \* All onsite portable toilets and temporary construction trailers are to be placed outside of the FEMA 100-year floodplain, unless otherwise approved by the TCI Floodplain Management team. It is the contractor's responsibility to suitably place these items.
- \* Any sanitary sewer bypass pumping required will be secured in a manner which minimizes movement and potential failure and protects natural waterways and/or flood waters from potential contamination. Adherence to approved Bypass Pumping Plan required.
- \* All existing ground located within the 100-year FEMA floodplain which is disturbed by construction activity shall be restored to original grade(s) and reasonable attempts made to re-establish vegetation.
- \* This FPDP permits construction activities for the following SAWS project only: SAWS W-6 Upper Segment: HWY 90 to SW Military Dr, Sewer Main (Job No: 19-4519). All other projects located in the 100-year floodplain will require a separate review and FPDP.
- \* PROJECT DESIGN CONSULTANT: Kimley-Horn (Phone: 210-541-9166) / TCI Floodplain Management Phone: 210-206-8433

Is Additional Information Required? No  
 Are other Federal, State, or Local Permits required? No  
 Permit Application - Reviewed By: Jeremy George, PE, CFM

**WARNING:**

**The flood hazard boundary maps and other flood data used by the Flood Plain Administrator in evaluating flood hazards to proposed developments are considered reasonable and accurate for regulatory purposes and are based on the best available scientific and engineering data. On rare occasions greater floods can and will occur and flood heights may be increased by man-made or natural causes. Issuance of this permit does not imply that land outside the areas of special flood hazards or that the uses permitted within such areas will be free from flooding or flood damages due to local conditions. Construction standards required by this permit are the minimum standards deemed necessary to minimize or eliminate flood damage, but reliance on these minimum standards shall not create liability on the part of the City, the Flood Plain Administrator or any officer or employee of the City of San Antonio in the event flooding or flood damage does occur.**

  
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 Permittee Initial

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. CONTRACTOR shall provide all labor, materials, equipment, supervision and incidentals required to furnish, install, and test carrier pipes as shown on the Contract Drawings or specified herein.
- B. The Drawings indicate the smallest diameter casing pipe that is acceptable for each installation. The CONTRACTOR may elect to use a larger diameter casing pipe at his discretion and at no additional cost to OWNER subject to review and approval by the ENGINEER. All minimum covers specified on the Contract Drawings must be maintained.
- C. Crossings shall be made at the following location:
  - 1. New 8” sanitary sewer main near Callaghan Rd and US 90 (36” minimum diameter casing pipe).
  - 2. New 12” sanitary sewer main near Leon Creek and US 90 (36” minimum diameter casing pipe).
- D. Coordination: CONTRACTOR shall carefully coordinate installation of casing pipes and carrier pipes with any other construction activities taking place at each crossing. Sequencing and by-pass pumping shall be as indicated on the Contract Drawings

1.02 RELATED WORK

- A. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- B. Section SS 02416 - Trenchless Crossing Jacking and Receiving Pits
- C. Section SS 02430 – Installation of Pipe in Tunnel
- D. Section SS 02431 – Annular Backfill for Carrier Pipe
- E. Section SS 02432 – Contact Grouting
- F. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. ASTM A 53, Specification for Pipe, Steel, Black and Hot-dipped, Zinc-coated, Welded and Seamless.
- B. ASTM A 106, Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
- C. ASTM A 139, Specification for Electric Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).
- D. ASTM A 153, Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
- E. ASTM A 307, Specification for Low Carbon Steel Externally and Internally Threaded Standard Fasteners.

- F. ASTM 500, Specification for Cold-Formed Welded Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- G. ASTM A 569, Specification for Hot Rolled Carbon Steel Sheets and Strip, Commercial Quality.
- H. ASTM S 252, Welded and Seamless Steel Pipe Piles.
- I. AWS D1.1, Structural Welding Code.
- J. Local and state codes and ordinances.
- K. OSHA.
- L. SAWS Standard Specifications for Construction
- M. TxDOT Standard Specifications for Highway Construction.

#### 1.04 DEFINITIONS

- A. Guided Boring: Trenchless construction method used to install a steel casing pipe under guidance including pilot tube methods or a steerable head such as a small boring unit or other similar type device that is compatible with the ground conditions at the site.
- B. Microtunneling: Trenchless construction method used to install a casing or carrier pipe by utilizing a remotely controlled small diameter rotary cutting head providing continuous face support.

#### 1.05 GROUND CONDITIONS

- A. The work will be performed through subsurface conditions which have been investigated for the purpose of developing assumptions about ground conditions. A Geotechnical Design Memorandum has been prepared for the trenchless crossings to present the ground conditions at each site. This GDM is not considered a baseline report and is not a guarantee of the ground conditions that could be encountered at the site. The purpose of the GDM is to provide guidance and recommendations to the CONTRACTOR and present the available data so that they may make their own interpretation of the risks and ground conditions involved at each trenchless crossing.

#### 1.06 CONTRACTOR QUALITY ASSURANCE AND QUALITY CONTROL

- A. Installer's Qualifications and Experience:
  - 1. Installer shall be a specialist in the construction of casing pipes by guided boring and/or microtunneling and shall have at least 5 cumulative years of experience in this specialty. Installer shall have satisfactorily constructed completely in his own name, during the past 5 years, not less than three similar installations that are comparable in diameter and length to that shown and specified herein using the proposed installation method required for each location.

2. Use only personnel thoroughly trained and experienced in the skills required. All field supervisors and machine operators shall have at least 12 months of experience in the operations of the equipment being used.
  3. Welds shall be made only by welders, tackers and welding operators who have been previously qualified by tests as prescribed in American Welding Society, AWS D.1.1 to perform the type of work required. Show proof of certification when requested by the OWNER'S Project Representative.
- B. Requirements of Regulatory Agencies:
1. The CONTRACTOR shall obtain and pay for all additional permits, provide insurance, bonds, and guarantees, and all else required by the governing authorities.
  2. The CONTRACTOR'S responsibility under this paragraph may include, but is not limited to the following:
    - a. Constructing and removing temporary facilities or structures.
    - b. Providing details of construction methods.
    - c. Providing detailed construction schedules.
    - d. Reimbursing the applicable governing authority for all expenses incurred in connection with the work.
    - e. Traffic maintenance.
    - f. Coordination of scheduling.
    - g. Clean up and restoration.
- C. Tolerances: The casing pipes shall be installed on the lines and grades shown on the Contract Drawings and within tolerances required to allow the carrier pipe to be installed in accordance with the lines and grades shown on the Contract Drawings and as specified herein.

#### 1.07 SUBMITTALS

- A. Shop Drawings: At least twelve weeks prior to construction, the CONTRACTOR shall submit shop drawings for review by the ENGINEER and OWNER'S REPRESENTATIVE including installation methods with detailed drawings and descriptions showing methods and equipment for the installation of the casing pipes and carrier pipes including means and methods for maintaining grade tolerances, as appropriate for each installation method. Drawings and calculations shall be signed and sealed by a registered Professional Engineer in the State of Texas and shall be submitted to ENGINEER for record purposes to ensure that the requirements of the Drawings and Specifications are complied with in full.
- B. Qualifications Data: Submit qualifications data as specified in Paragraph 1.4.A. Qualifications information on successful projects will include as a minimum:

1. Name and telephone of owners or engineers responsible for projects.
  2. Approximate contract cost for projects.
  3. Description of project including method of installation.
- C. Technical data, test reports, work schedules and any other information indicating compliance with these specifications.
- D. Certificates: Certificate of Conformance in accordance with Paragraph 21.1 of ASTM A139.
- E. Submit an approved highway traffic control plan in accordance TxDOT requirements if the traffic control plans in the Contract Documents do not represent the CONTRACTOR's desired traffic control.
- F. Submit a Safety Plan for all tunnel operations.
- G. Manufacturer information for materials required including casing pipe, casing spacers/insulators, end caps, etc.

#### 1.08 GENERAL REQUIREMENTS

##### A. General Criteria

1. The thrust block shall be constructed perpendicular to the proposed pipe alignment and shall be designed to withstand the maximum jacking pressure to be used, with a safety factor of at least 2.5. The CONTRACTOR shall have the sole responsibility for maintenance and protection of existing utilities, structures, and facilities within the zone of construction.
2. The CONTRACTOR shall have the sole responsibility for sizing the shafts within the easements and limits of construction shown on the Contract Drawings. The size of the excavations shall be adequate to construct all structures required and to gain access to tunneling operations for all materials, equipment, and personnel.
3. The CONTRACTOR shall carefully monitor machine penetration rate, face pressures (when applicable), and line-and- grade of the drive.
4. The CONTRACTOR shall carefully control slurry pressures applied at the tunnel face or around the casing to prevent fracturing of the ground and discharge of slurry to the ground surface.
5. The CONTRACTOR shall allow the ENGINEER and OWNER's REPRESENTATIVE access to the shafts, and to use the shafts to access tunnel operations.
6. The selected trenchless method (either guided bore or microtunnel) should be compatible with the groundwater conditions at each site. If groundwater is present the CONTRACTORCONTRACTOR is required to draw down the groundwater 2 feet below the invert of the trenchless crossing prior to beginning each trenchless



operation to prevent flowing conditions at the face or utilize a pressurized face microtunnel machine. Dewatering operations should be performed in accordance with Section SS 02442 – Dewatering & Control of Groundwater for Shafts and Tunnels.

7. Control ground surface settlement or heave above the centerline of the pipeline. The CONTRACTOR shall repair any damage resulting from surface settlement or heave caused by trenchless construction, or jacking and receiving pit excavation and construction at no additional cost the OWNER.

**B. Guided Bore Criteria:**

1. Guided borings shall be suitable for installation in the ground conditions and the diameter and distances shown in the Contract Drawings.
2. Guided borings should be capable of installing the casing and carrier pipe to the line and grade requirements stated herein.
3. Guidance is required and selection of cutter head for boring units or pilot tubes should match the ground conditions such that significant deflection or error during installation does not occur. This includes soft rock conditions and gravel with the possibility of limestone and chert cobbles.

**C. Microtunnel Criteria:**

1. Pressurized, closed face remotely operated microtunneling equipment shall be used for all microtunneling work described. The MTBM shall have the capability to provide a positive, stabilizing pressure at the tunnel face.
2. The MTBM shall be equipped with an automated slurry spoil transportation system capable of coordinating the material excavated with the rate of pipe installation. This slurry system shall have the ability to back-flush the slurry lines to avoid clogging the system. Additives or conditioners may be required to prevent clogging in ground with a high clogging potential such as fat clays with a high plasticity index.
3. Microtunneling and associated equipment selected by the CONTRACTOR shall be compatible with the ground conditions at the site and capable of crushing or grinding limestone or chert gravel and cobble materials.
4. Face pressure exerted at the heading by the microtunneling machine shall be maintained as required to balance ground and groundwater pressures present, and prevent loss of ground, groundwater inflows, and settlement or heave of the ground surface.

**D. Delivery:**

1. Exercise special care during delivery not to damage casing pipes and carrier pipes.
2. Damaged materials will be rejected by the OWNER's REPRESENTATIVE and replaced by the CONTRACTOR at their expense.
3. Deliver materials to such locations so as to avoid excessive handling.

- E. Storage:
  - 1. Store casing pipe, and conduits on approved blocking for protection from corrosion until incorporation into the Work in accordance with manufacturer's recommendation.
  - 2. The OWNER's REPRESENTATIVE and ENGINEER shall be permitted access to inspect the materials in storage areas.
- F. Handling:
  - 1. Handle materials in a manner so as to avoid damage.
  - 2. Materials damaged during handling shall be repaired or replaced as ordered by the OWNER's REPRESENTATIVE.

## **PART 2 - EXECUTION**

### **2.1 PRODUCTS**

- A. Steel Casing Pipe:
  - 1. Casing pipe shall be steel pipe meeting the requirements of ASTM A139, Grade B, leakproof construction. Pipe shall be seamless or have not more than one longitudinal weld.
  - 2. Inside diameter shall be as shown on the Contract Drawings unless approved by the ENGINEER otherwise. Minimum nominal thickness of steel casing pipe shall be a minimum of 0.375 inches, actual thickness shall be determined by the casing installer, based on an evaluation of the required forces to be exerted on the casing when jacking. Any buckling of the casing due to jacking forces shall be repaired at no additional cost to OWNER.
  - 3. Steel pipe shall have a minimum yield strength of 35,000 psi shall also meet the chemical requirements of ASTM A36.
  - 4. If the casing pipe is furnished in sections and the casing pipe requires field welding, then casing pipe shall be furnished with plain ends, mill beveled for field butt-welding. Field welded joints shall be performed by AWS D.1.1 certified welders and be full penetration single vee groove, butt type welds around the entire circumference of the pipe. All welding shall receive non-destructive testing. Copies of test reports shall be submitted the OWNER.
- B. Annular Backfill shall be in accordance with Section SS 02431 – Annular Backfill for Carrier Pipe.
- C. Contact Grout shall be in accordance with Section SS 02432 – Contact Grouting
- D. Carrier pipe for gravity wastewater use shall be of the material called out on the plans and in accordance with SAWS Standard Specification Item No. 848 – Sanitary Sewers.

- E. Casing Spacers/Insulators and End Caps shall be in accordance with SAWS Standard Specification Item No. 856 – Jacking, Boring or Tunneling Pipe, and SAWS Standard Material Specification 05-31.

## 2.2 EQUIPMENT

### A. General:

1. The main jacks shall be mounted in a jacking frame and located in the jacking shaft. The excavation shall be moved forward by the jacks advancing a successive string of connected casing pipes toward a receiving shaft.
2. A pipe lubrication system shall be used to lower the friction developed on the surface of the pipe during jacking operation. A lubricant, typically bentonite or polymers, shall be injected near the excavation face or through lubrication ports. This lubricant is subject to review by the ENGINEER.
3. The pipe lubrication system pressure shall be continuously monitored, recorded, and controlled to prevent pipe buckling and/or ground heave.
4. Thrust block shall be perpendicular to the proposed pipe alignment. The thrust block shall be capable of supporting the maximum jacking pressure developed by the main jacking system.
5. Operate the jacks so as not to exceed 80 percent of their rated capacity. At no time shall jacks be operated so as to exceed the axial capacity of the jacked pipe, including all safety factors. Provide additional jacking capacity, such as intermediate jacking stations, if the jacking requirements shall otherwise exceed 80 percent.
6. When intermediate jacking stations are utilized, the maximum jacking force shall not exceed the maximum allowable jacking load of the pipe

### B. Guided Boring Equipment:

1. Manufacturer of the guiding boring system shall have at least 5 years of experience in the design and manufacture of such systems and must still be in the business of manufacturing such devices in the event that site representatives, parts, or other equipment are required. All of the various components and systems, which make up the guided boring system shall be new or reconditioned so that the machine is ready to operate upon installation at the site.
2. Guided boring systems shall be capable of installing the carrier pipe within the grade and line tolerances specified herein up to the distance shown on the Contract Drawings.
3. The guidance system shall be capable of accuracies up to ¼ inch over 400 feet in the ground conditions at the site.

### C. Microtunneling Equipment:

1. Microtunnel Boring Machine (MTBM): The MTBM shall be a closed full-face machine designed and built or rebuilt for the ground conditions on this project by a recognized MTBM manufacturer with at least 5 years of experience in the design and manufacture of MTBMs of this type. The manufacturer must still be in the business of designing and manufacturing MTBMs. All of the various components and systems, which make up the MTBM shall be new or reconditioned so that the machine is ready to operate upon installation at the site. It shall be able, with excess capacity, to handle the range of ground conditions at the site and shall satisfy the following requirements:
  - a. The machine shall be capable of fully supporting the face during both excavation and shutdown periods, and shall have the capability of exerting a controllable, measurable, continuous, stabilizing pressure at the face as required to prevent loss of ground. The system shall be capable of adjustments required to balance the earth pressures at the tunnel face to an accuracy of one foot of equivalent hydrostatic pressure. The machine shall utilize a synchronized slurry transportation system with machine advance rate to avoid over excavation or loss of ground. The microtunneling system shall be capable of back flushing to clear debris that may be encountered.
  - b. Provide a machine with an enclosed chamber for containing the slurry under pressure. A pressure gauge should be provided so that operator can monitor the chamber pressure. The system shall be capable of making the adjustments required to counterbalance the earth pressures as needed to prevent loss of ground.
  - c. The machine shall be remotely operated, guided, and monitored continuously by the operator. A display showing the position of the machine in relation to design line-and-grade shall be provided at the operation console to allow the operator to monitor face pressure, roll, inclination, laser position, steering attitude, slurry face pressure, rate of advance, installed length, thrust force and cutterhead torque. The machine shall have a data logger that records all the above at a minimum of 10 minutes intervals to a portable digital storage device in a format that can be imported into Microsoft Excel. This portable digital storage device shall be submitted to the OWNER's REPRESENTATIVE on a daily basis and shall be the property of the OWNER.
  - d. The machine shall have a guidance system capable of accuracies up to ¼ inch over 400 feet in the ground conditions at the site.
  - e. The machine shall have an articulated shield that is steerable in both vertical and horizontal directions to maintain line-and-grade within the specified tolerances. The cutterhead shall have a reversible drive system so that it can rotate in either direction to minimize rotation or roll of the pipe during installation.
  - f. The machine shall be capable of advancing through the ground conditions at the site including but not limited to groundwater, soft rock, gravel, and cobbles. The CONTRACTOR shall submit a letter from the MTBM manufacturer or rebuilding certifying that the equipment being supplied for the Project is capable of excavating the ground at the site.

- g. Slurry used to support the microtunnel face and to remove excavated muck may need to be produced using bentonite or polymer additives. It is the CONTRACTOR's responsibility to tailor the slurry to the encountered geologic conditions.
  - h. Provide a slurry separation plant that is appropriate for the ground being excavated, and compatible with the anticipated excavation rate, effective in removing the spoil from the slurry, and is acceptable in terms of the available construction staging areas.
  - i. The machine shall be equipped for continuous gas monitoring and shall have a shut-off switch.
  - j. A pipe lubrication injection system shall be provided to inject pipe lubricants as required to minimize jacking force.
  - k. The tail of machine shall have gaskets and seals to prevent material from running into the tunnel at the contact between the tail skin and the pipe.
  - l. The maximum allowable over-cut shall not be greater than 2 inch larger in radius than the outside of the jacked pipe.
2. Automated Spoils Transportation:
- a. Slurry System: The system shall be capable of measuring earth and groundwater pressure and making the adjustments required to counter-balance the earth and groundwater pressure to prevent loss of slurry or uncontrolled ground and groundwater inflow and shall satisfy the following requirements:
    - 1) The slurry pressure at the excavation face shall be controlled by use of slurry pumps.
    - 2) A slurry bypass method shall be included to allow for a change in direction of flow to be made and /or isolated.
    - 3) Provide a separation process, properly sized for the tunnel being constructed, the ground type being excavated, and the workspace available at each area. Separate the spoil from the slurry so that slurry shall be returned to the cutting face for reuse.
    - 4) Monitor the composition of the slurry to maintain the slurry density and viscosity limits as reviewed in the submittals.

## **PART 3 - EXECUTION**

### **3.1 EXECUTION**

#### **A. General:**

1. Lines and Grades: The CONTRACTOR is responsible for maintaining proper line and grade at each crossing.
    - a. The CONTRACTOR shall install the center of the casing to within 2 inches of the planned location and such that it does not interfere with flowlines established on the Contract Drawings.
    - b. The CONTRACTOR shall periodically check his line and grade to assure conformance with line and grade shown on the Contract Drawings and within the tolerances indicated in this Section.
    - c. Extra work required because of the CONTRACTOR'S failure to maintain the proper line and grade shown on the Contract Drawings, shall be performed by the CONTRACTOR, at no additional cost to the OWNER.
  2. Protection: Guardrail, fences, signs, lights, barricades, barrels, and all other protective items necessary shall be provided in accordance with the requirements of all applicable permits, laws, regulations, and ordinances, and as necessary to prevent damage or injury to private or public property or to workmen or the general public.
  3. Adequately support and protect utilities and facilities that are encountered in or may be affected by the Work.
  4. All excavations shall be sheeted, shored and braced as required to prevent subsurface subsidence in accordance with Section SS 02416 – Trenchless Jacking and Receiving Pits.
  5. Construct all pits prior to beginning tunnel (trenchless) excavation.
  6. Boring pits and tunnel alignment shall be kept dewatered to 2 feet below the pit invert or casing invert, and pumps shall be attended on a 24-hour basis, if conditions require.
  7. Maintain the air quality in the pipe, when access is required, in a condition suitable for the health of workers at all times.
- B. Preparation
1. Work pits at each end of the crossings shall be sufficiently large to permit satisfactory installation of the casing pipe. All excavation, backfill, sheeting, shoring, bracing, and dewatering shall comply with the applicable requirements of the applicable authorities and local, state, and federal regulations and shall be designed in accordance with Section SS 02416 – Jacking and Receiving Pits and Section SS 02442 – Dewatering & Control of Groundwater for Shafts & Tunnels.
  2. CONTRACTOR shall dispose of excess excavated material or drilling mud/cuttings in an approved offsite disposal location.
- C. Installation
1. General Installation Requirements

- a. Pipe installation shall be completed in accordance with reviewed submittals.
  - b. Provide a suitable jacking frame and thrust block to carry out the Work. Provide intermediate jacking stations, if required, to complete the required drives. Intermediate jacking stations shall be provided when the total anticipated jacking force needed to complete the drive exceeds the capacity of the main jacks or the maximum allowable jacking force on the casing pipe.
  - c. Special care shall be taken when setting the casing pipe guide rails prior to starting the Work in the jacking pit to ensure correctness of the alignment, grade, and stability. Survey the location and orientation of the guide rails to ensure they are on the proper line-and-grade and verify that they are properly supported.
  - d. Casing pipe and carrier pipe sections shall be handled and transported from the storage area to the jacking pit properly in accordance with the manufacturer's recommendations to avoid damage. Set the casing pipe sections properly, braced and supported by guide rails. Join the two sections together following the connection procedures or as indicated in reviewed submittals.
  - e. The axial forces from the thrust jacks shall be distributed to the casing pipe uniformly through a properly designed thrust ring and cushion materials to prevent damage to the ends of the casing. Jacking forces shall be applied uniformly to the casing wall. The jacking system shall be capable of continuously monitoring the jacking pressure and advance rate.
  - f. Casing pipe shall be jacked into position following the design line-and-grade of the pipeline without damaging the casing. In the event a section of the casing pipe is damaged during the jacking operation, the casing pipe shall be jacked through to the receiving shaft and removed. Other methods of repairing the damaged pipe may be used, subject to the review by the ENGINEER.
  - g. Provide a lubrication system and inject lubricants through injection ports in the jacking pipe as necessary, to minimize friction. Lubricants shall be injected continuously as the pipe is advanced. The volume injected shall not be less than that required to fill the annular void space outside the pipe.
  - h. If voids develop around the casing pipe as it is bored, pump cement grout to fill all such voids, or fill by other means acceptable to the ENGINEER. Fill all voids as specified hereinafter as soon as possible after completion of boring operation. Grouting should be done in accordance with Section SS 02432 – Contact Grouting.
  - i. Monitor line-and-grade periodically during operations. Record deviation with respect to design line-and-grade and submit records to the ENGINEER and OWNER's REPRESENTATIVE as requested. Control line-and-grade of the pipe to within the specified tolerances.
2. Installation of Steel Casing Pipe by Guided Boring:
    - a. Utilize an auger rotating inside the pipe to remove the soil.

- b. Borings utilizing this method of installation should be guided by a pilot tube or steerable head such that proper line and grade is maintained during installation.
  - c. The use of specialized cutting heads or three-pass systems are acceptable and may be required for the given ground conditions.
  - d. Install suitable equipment on the front of the casing pipe that will positively prevent the auger and cutting head creating unsupported excavation ahead of the pipe.
  - e. The equipment used to bore and remove the earth shall be removable from within the casing pipe in the event an obstruction is encountered.
  - f. If voids develop around the casing pipe as it is bored, pump cement grout to fill all such voids, or fill by other means acceptable to the ENGINEER. Fill all voids as specified hereinafter as soon as possible after completion of boring operation. Grouting should be done in accordance with Section SS 02432 – Contact Grouting.
3. Installation of Steel Casing Pipe by Microtunneling:
- a. Pressure applied at the tunnel face during microtunneling shall be maintained at all times between the measured earth pressure and 50 percent of the estimated earth pressure. Pressure applied at the tunnel face to balance the groundwater shall be maintained at a level slightly in excess of normal hydrostatic pressure and shall be monitored continuously.
  - b. The microtunneling machine shall be operated so as to minimize both surface heave and loss of ground during microtunneling. Restrict the excavation of the materials to only those materials that are physically displaced by the shield itself in order to prevent loss of ground and settlement or possible damage to overlying structures. Control the advance rate and monitor the volume of material excavated and adjusted advance rate, as required to avoid loss of ground, over excavation and surface heave.
  - c. The microtunneling machine shall be steered to maintain line-and-grade within the tolerance specified. This shall be achieved by continuously monitoring line-and-grade, machine inclination, roll, and steering attitude during the operation.
  - d. Chamber pressure, torque, rate of advance, thrust force, slurry pressure, distance along the drive, deviation from line-and- grade, roll, and steering altitudes shall be monitored and recorded for each pipe section installed.
  - e. Use slurry spoil transportation system for all microtunneling. Monitor slurry pressure and adjust as required to adequately balance earth pressures.
  - f. A separation plant shall be provided for microtunneling operations to remove the excavated soilground from the slurry for disposal. Use settlement tanks, shakers, vibrating screens, hydro-cyclones and centrifuges as required for effective spoil removal.



- g. Properly transport and dispose of all excavated materials away from the construction sites in accordance with all applicable City, County, State, and Federal regulations. Slurry from microtunneling operations shall be pumped into tanker trucks and properly disposed of at acceptable facilities in accordance with current City, County, State, and Federal regulations for disposal of these materials.
- 4. Annular Backfill and Grouting:
  - a. Contact grouting shall be performed in accordance with Section SS 02432 – Contact Grouting.
  - b. Annular backfill shall be performed in accordance with Section SS 02431 – Annular Backfill.
- 5. Obstructions: During casing pipe installation, if an obstruction is encountered which stops the forward action of the casing pipe, and it becomes evident that it is impossible to advance the pipe, the CONTRACTOR must stop work and propose a method for removing the obstruction or providing an alternative crossing location at the approval of the OWNER’s REPRESENTATIVE and ENGINEER.
- 6. Carrier Pipe Installation: Carrier pipes shall be installed in accordance with the requirements and details of SAWS Standard Specification Item No. 856 – Jacking, Boring or Tunneling Pipe.

#### **PART 4 - MEASUREMENT AND PAYMENT**

Measurement and payment of items included in this section will be paid based on:

- 1. The linear footage for the excavation via guided boring or microtunnel (36-inch).
- 2. The linear footage for the installation of steel casing pipe (36-inch).
- 3. The linear footage for the installation of the carrier pipe installed in bore/microtunnel casing pipe (8-inch).
- 4. The linear footage for the installation of the carrier pipe installed in bore/microtunnel casing pipe (12-inch).

Payment items will be prepared separately for each size of excavation. Carrier pipe used in bores/microtunnels is measured based on the linear foot of pipe installed inside casing pipe. Linear feet will be rounded to the nearest linear foot. All temporary works required to excavate and support the tunnel opening, initial support, contact grouting, dewatering and handling water, and all products, materials, and labor required are to be considered incidental to the per liner foot payment for this scope. Payment will be paid at the agreed upon unit price in the Contract Documents.

**END OF SECTION**

**PART 1 - GENERAL**

1.01 SCOPE OF WORK

- A. Design and furnish all labor, materials, equipment, and incidentals required to provide all excavating, sheeting, shoring and supports shown, specified and required for construction of jacking and receiving pits, and other pits as may be required to complete the Work. These shall include a system of supports, including all bracing and associated items, to retain excavations in a safe manner and to control ground movements within tolerable limits. This may also include ancillary items such as reaction blocks, leveling pads, etc. Upon completion of the required tunnel construction, remove the system of supports as specified, and restore the pit and staging area sites.
- B. The size of the pits shall be adequate to construct all structures required. Pit excavations shall be contained within the limits shown on the Contract Drawings. Pit excavation size shall be subject to the review of the ENGINEER.
- C. Pits shall be located at the proposed locations as shown on the Contract Drawings unless otherwise reviewed by the ENGINEER and OWNER's REPRESENTATIVE.

1.02 RELATED WORK

- A. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- B. Section SS 02415 – Trenchless Crossings by Guided Boring or Microtunneling
- C. Section SS 02431 – Annular Backfill for Carrier Pipe
- D. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction.
- B. Comply with applicable provisions and recommendations of the following except as otherwise shown or specified.
  - 1. American Institute of Steel Construction (AISC): Manual of Steel Construction, Allowable Stress Design
  - 2. ASTM A36 - Specification for Carbon Structural Steel.
  - 3. ASTM A328 - Standard Specification for Steel Sheet Piling
  - 4. ASTM A992 - Standard Specification for Structural Steel Shapes
  - 5. American Welding Society (AWS) – AWS D1.1 for Public Works Construction

6. OSHA Standard, Title 29, Code of Federal Regulations, Part 1926, Section .650 (Subpart P - Excavations).

#### 1.04 GROUND CONDITIONS

- A. The work will be performed through subsurface conditions which have been investigated for the purpose of developing assumptions about ground conditions. A Geotechnical Design Memorandum has been prepared for the trenchless crossings to present the ground conditions at each site. This GDM is not considered a baseline report and is not a guarantee of the ground conditions that could be encountered at the site. The purpose of the GDM is to provide guidance and recommendations to the CONTRACTOR and present the available data so that they may make their own interpretation of the risks and ground conditions involved at each trenchless crossing.

#### 1.05 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Refer to Section SS 02415 – Trenchless Crossings by Guided Boring or Microtunneling.

#### 1.06 SUBMITTALS

- A. Submit information regarding pit excavations, excavation support systems, and other related information as requested by the ENGINEER a minimum of twelve weeks prior to tunnel excavation, including the following:
  1. Construction method to be used for the installation for excavation support system design.
  2. Pit locations and sizes.
  3. Shop drawings and design calculations indicating arrangements of supports and construction sequence for proposed support system(s) signed and sealed by a Professional Engineer in the State of Texas.
  4. Breakout plans indicating support installed to transfer loads and maintain excavation support and stability of the excavation when commencing tunneling operations and when holing out in exit pits.
  5. Thrust block/backstop design and details.
  6. Quality control procedures. Address materials testing requirements, proof-test and performance test requirements for tiebacks, and excavation monitoring provisions.
  7. A site plan for each excavation indicating the location, excavation dimensions, site grading, and site development details for the excavation and all work areas, and the proposed limits of disturbance surrounding each excavation.
  8. Provisions for protecting and monitoring adjacent facilities and utilities. All utilities within 25 feet of excavations and all structures within 50 feet of excavations shall be addressed.

9. Site drainage and groundwater control details. Show details of the measures to control, treat, handle, and dispose of surface water runoff, groundwater, and construction water. Provide details of working slab, subdrains, and sump construction.
10. Details of materials handling, stockpiling, and disposal sites for excavated materials.
11. Layout and details for Geotechnical and Instrumentation Monitoring Plan for monitoring structures, roadway, and existing utilities per Section SS 01520 – Geotechnical Instrumentation and Monitoring.
12. Plans indicating layout of guardrail barrier system around open pits in accordance with OSHA requirements.
13. Plans indicating removal of excavation supports and site restoration details.
14. Plans for environmental controls.
15. Copies of all documentation, releases, and permits required herein and necessary to complete the work. Documentation, releases, and permits shall include but not be limited to imported materials, material disposal, utility disturbances, and affected properties.

#### 1.07 GENERAL REQUIREMENTS

- A. Design pit excavation support systems and working slabs to withstand earth pressures, unrelieved hydrostatic pressures, bottom heave, equipment loads, applicable traffic and construction loads, and other surcharge loads to allow the safe construction of the tunnel or jacked pipe without movement or settlement of the ground beyond specified tolerances, and to prevent damage to or movement of adjacent structures, streets, utilities or the newly installed pipeline or structures.
- B. Design the support system to minimize horizontal and vertical movements, and to protect adjacent utilities from damage. Design support system to maintain the stability of the excavation and provide a factor of safety of at least 1.5 against sliding, global stability, and against bottom heave.
- C. Design a working slab for each pit bottom to provide stable support for guide rails, thrust blocks, and other construction operations.
- D. Design, install, operate, and maintain groundwater control system for excavations to control any groundwater inflows, prevent piping or loss of ground, and maintain stability of the excavation.
- E. Locate pits within the allowable locations indicated on the Contract Drawings unless otherwise approved by the ENGINEER.
- F. Provide temporary concrete safety K-railing and fencing around pit excavations. Provide traffic control around working areas and pits as shown on the Drawings.
- G. Design excavation support systems in accordance with all applicable OSHA requirements.
- H. Review and approval of the CONTRACTOR's plans and methods of construction by the ENGINEER does not relieve the CONTRACTOR of his responsibility to provide and maintain an adequate support system achieving the specified requirements.

- I. Dewater pit excavations where groundwater is present to a minimum of 2 feet below shaft excavations in accordance with Section SS 02442 – Dewatering & Control of Groundwater for Shafts and Tunnels.

## **PART 2 - EXECUTION**

### **2.1 PIT LOCATIONS AND SIZE**

- A. Pit construction shall be limited to the locations shown on the Drawings, unless otherwise reviewed by the ENGINEER and OWNER's REPRESENTATIVE.
- B. Pit size shall be adequate for construction of any permanent structures indicated on the Contract Drawings and to provide adequate room to meet the CONTRACTOR's operational requirements for tunnel construction and for backfill. Pit excavations shall be contained within the easement or public right-of-way.

### **2.2 PIT CONSTRUCTION**

- A. Provide pit excavations with a gravel pad or concrete working slab equipped with a sump to pump out construction water and storm water.
- B. The working slab may be left in place for manhole support if the foundation has been reviewed by the ENGINEER prior to placement of the slab and no subsequent disturbance to the foundation has occurred.
- C. Access in and out of the pits for inspections by the ENGINEER or OWNER shall be provided when coordinated with the CONTRACTOR at least 24 hours in advance.

### **2.3 INSTRUMENTATION AND MONITORING**

- A. Install instrumentation in accordance with Section SS 01520 – Geotechnical Instrumentation and Monitoring.

### **2.4 MAINTENANCE**

- A. Pits shall be kept dewatered, and pumps shall be attended on a 24-hour basis, if conditions require. Maintain close observation to detect any displacement of facilities during dewatering operations. Provide backup systems if dewatering is required to ensure 24-hour dewatering is provided in the event of a failure of the primary system.
- B. Provide adequate ventilation in pits at all times. Air quality in the pit shall be tested continuously during use of the pit.
- C. Provide adequate lighting in the tunnel pit and around equipment being utilized. Power and lighting circuits shall be separated and thoroughly insulated.

### **2.5 REMOVAL OF SUPPORT SYSTEM**

- A. Remove all sheeting, shoring and bracing at the completion of work unless otherwise approved in writing by the OWNER's REPRESENTATIVE.

2.6 WATER CONTROLS

- A. Provide ground water control and drainage from pits while work is in progress and until adjacent pipe joints have been properly sealed and the pit is properly backfilled.
- B. Divert surface water runoff from the pit and protect the pits from infiltration or flooding by surface water, including discharge from any dewatering operation.

2.7 SAFETY

- A. Security fencing shall be placed around the CONTRACTOR's work area with appropriate signage and lighting.
- B. Construct a railing around the periphery of the pit meeting applicable safety standards.
- C. Properly maintain the fence and railing throughout the period the pit remains open. Repair broken boards, supports, and structural members.
- D. Provide a full cover or other security barrier for each access pit in which there is no construction activity or which is unattended by the CONTRACTOR's personnel.

**PART 3 - MEASUREMENT AND PAYMENT**

No separate measurement or payment shall be made for items described in this section. All items associated with this section will be incidental to items under Section SS 02415 - Trenchless Crossings by Guided Boring or Microtunneling.

**END OF SECTION**

## **PART 1 - GENERAL**

### 1.01 SCOPE OF WORK

- A. This section specifies requirements for the design, procurement, installation and execution of Pressurized Face Tunneling utilizing an Earth Pressure Balance TBM (EPBM). This section also includes the installation of initial support and grouting behind this support. Additional requirements for initial support are described in Section SS 02420 – Steel Liner Plate and Section SS 02421 – Precast Concrete Segmental Liner.

### 1.02 RELATED WORK

- A. Section SS 01510 – Pre and Post-Construction Inspections
- B. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- C. Section SS 02410 – General Tunneling Requirements
- D. Section SS 02412 – Tunneling with Non-Pressurized Shielded TBM
- E. Section SS 02413 – Hand Mining
- F. Section SS 02420 – Steel Liner Plate
- G. Section SS 02421 – Precast Concrete Segmental Liner
- H. Section SS 02422 – Shotcrete
- I. Section SS 02430 – Installation of Pipe in Tunnel
- J. Section SS 02431 – Annular Backfill for Carrier Pipe
- K. Section SS 02432 – Contact Grouting
- L. Section SS 02440 – General Shaft Requirements
- M. Section SS 02441 – Secant Pile Walls
- N. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

### 1.03 DEFINITIONS

- A. Refer to Section SS 02410 – General Tunneling Requirements for additional definitions.
- B. Excavation Chamber: The enclosed space directly to the rear of the cutterhead and ahead of the main bulkhead for the EPBM.
- C. Ground Conditioning System (GCS): A system which permits the metered delivery of soil conditioners into the tool gap, excavation chamber, and screw conveyor of the EPBM.
- D. Tail Void Grout: Granular cement-based grout injected into the Tail Void for the purpose of establishing intimate contact between the ground and the initial support.

- E. Tail Void: Annular volume between the TBM excavation limits, including overcut, and the outside surface of the initial support.

#### 1.04 GROUND CONDITIONS

- A. The work will be performed through subsurface conditions which have been investigated for the purpose of developing assumptions about ground conditions. Both a Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR) have been prepared based on this information.
- B. The primary objective of the GDR is to present the results of geotechnical investigations conducted for the project in a factual manner. These results include descriptions of field and laboratory investigations performed and procedures used, background physiography and regional geology information, and summaries of site subsurface conditions.
- C. The primary objectives of the GBR are to present the ENGINEER's interpretation of subsurface conditions and ground behavior, to present the basis of geotechnical design, to describe how these conditions might affect tunnel construction, and to present the geotechnical "baseline" for design that will be the basis for bidding, and resolution of potential differing site conditions with respect to the occurrence of different ground types and ground water anticipated for the work.

#### 1.05 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Qualifications:
  - 1. All personnel employed by the CONTRACTOR or Subcontractor in the work will be experienced and competent in their respective tasks and will work only under the direct control of a suitably experienced supervisor.
  - 2. Personnel who were presented in the submittal will be onsite and/or involved in the work as required. Personnel may only be substituted if they meet the minimum requirements herein.
  - 3. EPBM Manufacturer: Firms manufacturing or rebuilding EPBMs for this project shall be a recognized EPBM manufacturer with at least five years recent experience manufacturing or refurbished by an equivalent company who routinely performs EPBM refurbishment and is acceptable to the ENGINEER and OWNER'S REPRESENTATIVE.
  - 4. Site Superintendent with a minimum of five years total on-the-job tunnel supervision experience. Specific experience requirements to be listed shall include:
    - a. Types of EPBMs used.
    - b. Tunneling of similar size and footage.
    - c. Initial lining consisting of pre-cast concrete segments or gasketed liner plate.
    - d. Tunnels driven through ground conditions similar to those indicated in the Contract Documents.
  - 5. Shift Foremen with a minimum of five years on-the-job tunnel crew supervision, experience with the EPBM tunneling of similar size, with precast concrete segment or gasketed liner plate initial lining, and in similar ground conditions.
  - 6. EPBM operators with experience operating and guiding an EPBM in two projects of similar type, size, and length in the last ten years.
  - 7. All operators, master mechanics, electricians shall be certified as trained by the machine manufacturer to work on and support the EPBM before and during start up procedures of the EPBM. Training shall continue after initial launch mining and continue for a minimum of two months or 1,000-feet of tunneling whichever is greater. The manufacturer's



representative, or representative of the company that performed the machine refurbishment, shall be onsite for a minimum of two months or 1,000-feet of tunneling whichever is greater.

8. A Conditioner Specialist with a minimum three years on-the-job experience designing conditioner for EPBM tunneling of similar size and in similar ground conditions.
9. A Tunnel Grouting Supervisor for the grouting program that is knowledgeable of all aspects of grouting as currently practiced, including: (a) tail void backfill grouting; (b) check grouting methods through the lining; and (c) grout formulation, properties, admixtures, mixing methods, grout pumping and grout injection.
10. EPBM Manufacturers' Representative shall be a senior technician with a minimum of five years of experience in all aspects of EPBM operation and maintenance.
11. Design of engineered structures including initial support will be signed and sealed by a Registered Professional Engineer in the state of Texas with a minimum of five years of experience in structural design for tunnels and/or shafts as appropriate.
12. CONTRACTOR's surveying shall be performed by a Land Surveyor licensed with a minimum of five years of experience. Surveyor must have previously worked on two tunneling projects. Surveyor shall demonstrate underground surveying experience including the transfer of line and grade from the surface to below the surface and the ability to survey curved alignments.
13. The Safety Supervisor shall have at least five years of experience in safety management on at least two separate tunneling projects.

#### 1.06 SUBMITTALS

- A. Submittals shall be in accordance with Section SS 01300 – Submittals.
- B. Submit a Pressurized Face Tunneling Excavation Plan to include the following:
  1. Submit one integrated and structured file that presents an organized collection of data, plans, and method statements and which incorporates sections for the specified aspects of the tunneling work.
  2. The Pressurized Face Tunneling Excavation Plan shall be submitted at least 12 weeks prior to commencement of all tunneling operations utilizing an EPBM.
  3. Submit detailed description and drawings of the launching and receiving shafts including, but not limited to, seals, ground improvement, and supplemental supports and all installations required for the EPBM launching and receiving operations.
  4. Submit detailed description of tunneling procedures, methods, techniques, and operational sequences that will be used to advance the EPBM, control ground behavior, and steer EPBM through the different geologic conditions and combinations of conditions presented in the GBR and GDR. This shall include but not be limited to:
    - a. Launching and receiving operations.
    - b. Tunnel excavation with face support application.
      - 1) System for removing cuttings from the cutting chamber while maintaining face pressure.
      - 2) System for delivering to the face bentonite, foam, or other conditioning agents required to develop an effective soil plug and prevent sticking or clogging.
      - 3) Face support calculations.
      - 4) Methods for preventing, controlling, and dealing with clogging and sticking behavior.
    - c. EPBM guidance control system.
    - d. Size, thickness and dimensions of initial lining proposed by CONTRACTOR, including the following:

- 1) Calculations, signed and sealed by a registered Professional Engineer illustrating that the selected dimensions of the initial support elements as proposed by the CONTRACTOR, can accommodate ground loads, transport loads, swell pressures/strains and any jacking forces imposed by the CONTRACTOR'S chosen equipment.
  - 2) Demonstration that the CONTRACTOR'S chosen means and methods for excavating the tunnel and supporting the ground is compatible with the ground conditions described in the GBR, and that the initial support elements are compatible with the CONTRACTOR'S equipment selection.
  - e. Methods of erecting the initial support elements proposed by CONTRACTOR including estimate of installation/erection rate.
  - f. Methods of erecting initial support using with mechanical or vacuum erection system, or other initial support systems, proposed by CONTRACTOR including estimate of installation/erection rate.
  - g. Continuous tail void grouting.
  - h. Inspection stops, including:
    - 1) Cutterhead inspection.
    - 2) Maintaining face stability during inspection stops and immediately after EPBM startup.
    - 3) Refilling of the excavation chamber after inspection.
  - i. EPBM maintenance:
    - 1) Plans for maintaining face stability during inspection stops and immediately after EPBM startup.
    - 2) Refilling of the excavation chamber after maintenance work is complete.
  - j. Tunnel system monitoring, data acquisition system, and recording system.
  - k. Excavated soil handling and transport systems.
  - l. Detailed description of the means and methods necessary to meet the specified requirements: maintaining face stability, preventing blow-out maintenance, work in the excavation chamber, keeping ground movements at or below Action Levels, as defined in Section SS 01520 – Geotechnical Instrumentation and Monitoring, and measures for protection of adjacent property.
  - m. EPBM launch procedure plan and working statement.
  - n. EPBM removal procedure plan and working statement.
5. Complete Manufacturer's literature and shop drawings, and any modifications describing in detail the EPBM that will be used. As a minimum, this submittal shall include:
- a. Detailed, scaled general arrangement drawings of EPBM and backup equipment arrangement with sufficient and relevant vertical and horizontal longitudinal sections along the tunnel axis and cross sections.
  - b. Details of cutter head design and overcut, cutter and cutter mount design along with method of cutter access and changes, conditioning systems, operational criteria of power, thrust, and torque, articulation, steering systems, drive systems, propulsion system including jacks and methods of pushing off initial liner, main bearing and seals, tail seals, shield design, EPBM guidance system, EPBM data acquisition and management system, control mechanisms for maintaining positive pressure on face, pressure cells, water pumps for EPBM and tunnel, lighting system(s), personnel transport, communication system, tunnel shield gap injection system and backfill and angle hole grouting system, compressed air locks (as applicable), fire suppression system(s), schematic of electrical system(s), ventilation systems, initial support erector, hydraulic system schematic including lube system(s) support unloading/transport to erector and interface of EPBM with initial support.

- c. Description and shop drawings illustrating the guidance system for both line and grade controls.
  - d. Details of tunnel spoil transport system, tunnel spoil removal systems, and muck weight and volume systems.
  - e. Details of methods to be used to measure volume or weight of excavated material from the face.
  - f. For used machines, a brief listing of previous jobs for which the EPBM has been used. Include job name, length, duration, and ground condition summary.
  - g. Muck Control System procedure, calibration and verification.
  - h. EPBM pressure cell calibration procedure and verification.
  - i. Procedures for converting machine from pressurized (closed mode) to non-pressurized (open mode) if applicable.
6. Tunneling Schedule, including:
- a. Schedule for the design, manufacturing, shop erection and testing, dismantling, and shipment to the work site of the EPBM and all backup equipment and systems.
  - b. Assembly time, start-up time, and on-site training period planned to reach routine tunneling progress rates for execution of the Work.
  - c. Excavation and lining cycles for alignment including estimated average liner erection rate in minutes per ring.
  - d. Estimated average advance for tunnel feet/day. Include detailed accounting of resources utilized (rolling stock, surface equipment, tunnel equipment) and hours and shifts to be worked to achieve predicted rates.
  - e. Schedule for converting machine from pressurized (closed mode) to non-pressurized (open mode) if applicable.
7. Mix Designs.
- a. Conditioning agent formulation by soil or rock type, developed by a qualified specialist Conditioner Engineer.
  - b. Tail grouting formulation including:
    - 1) Proportions of all constituents.
    - 2) Properties of the wet mix.
8. Certifications:
- a. Conditioners.
  - b. Lubricants, oils, greases, etc.
  - c. Class 1 Division 2 for EPBM and trailing gear electrical systems.
  - d. Diesel locomotives meet MSHA 30 CFR 36.
  - e. Lifting and hoisting equipment.
  - f. Detailed narrative and support documents demonstrating the suitability of the EPBM and backup for tunneling in the ground conditions as represented in the GDR and GBR.
  - g. Written certification from EPBM manufacturer of full and complete design coordination between EPBM manufacturer and liner manufacturer. Include a written certification by both manufacturers affirming the compatibility of total EPBM system and ancillary equipment with lining, support erector and backfill grout system.
  - h. Statement from the EPBM manufacturer or firm responsible for EPBM rebuilding documenting that the main bearing of machines to be furnished can perform the excavation work with a minimum safety factor of 1.5 on a required minimum L10 life of 10,000 hours.
  - i. Machine manufacturer or rebuilder certifications stating that, as appropriate, the following equipment and parts are new or in like-new condition: cutterhead; drive train including motors, clutches, gear boxes, pinion gears, bull gear, main bearing, hydraulic system including pumps, pistons, cylinders, seals, electrical system, muck buckets, and muck removal system.

- j. Main bearing:
  - 1) Provide certification from the main bearing manufacturer that the bearing is suitable for the loads calculated by the EPBM manufacturer based upon the geotechnical conditions indicated in the GDR and GBR.
  - 2) From the EPBM manufacturer that the EPBM and associated components meet all the requirements indicated in the Contract Documents.
  - 3) A plan for replacing the main bearing, main bearing seal, and boil gear form inside the tunnel, if necessary.
9. Contingency Plan for:
  - a. Modifications to the tunnel excavation procedures if Ground Loss occurs.
  - b. Corrective actions to be utilized for each threshold level associated with settlement and ground monitoring.
  - c. Procedures for protection of adjacent facilities and property if excessive Ground Loss occurs or ground movements exceed Threshold Values specified in Section SS 01520 – Geotechnical Instrumentation and Monitoring.
  - d. Repair of unacceptable initial support off-sets, damage or spalling.
  - e. Loss of communication between top and bottom of shaft and between top of shaft and EPBM operator.
  - f. Fire.
  - g. Gas alarm activated.
  - h. Power loss.
  - i. Obstructions.
  - j. Clogging.
  - k. Corrective actions and alignment recovery procedures to be utilized for each alignment control response level as specified herein.
- C. Submit Test Reports to include:
  1. EPBM Factory Tests.
  2. EPBM site tests and re-calibration.
  3. Ground Conditioning System settings for expected soil types.
  4. Tail void grouting preliminary suitability tests.
- D. Submit Informational Submittals to include:
  1. Staff organizational chart including management personnel, superintendent(s) and foreman.
  2. Qualifications:
    - a. Submit detailed qualifying project experience, including project references with phone numbers, for the site superintendent, shift foremen, EPBM operators, conditioner specialist, the EPBM Manufacturers' Representative, Site Safety Representative, and the professional Land Surveyor.
    - b. Demonstrate the EPBM manufacturer/supplier under consideration has manufactured at least two pressurized face tunnel boring machine in the last 10 years of similar type and capability that has been successfully used in an environment and conditions similar to those in this Contract. Machine manufacturer to provide the following documentation for the EPBM project(s):
      - 1) Features of the EPBM, with a technical description and detailed general arrangement drawings of EPBM and backup equipment, included but not limited to cutters, drag bits, cutterhead and overcut, cutter and drag bit changing wear and detection system, cutterhead wear and protection system, conditioner injection and soil conditioning system for EPBM cutterhead percent of face opening, integrated support pressure control system, thrust and steering systems, cutterhead drive

system, tunnel spoil system, main bearing seals, joint and tail seals, guidance systems, backfill tunnel grouting provisions, provisions for personnel and equipment lock for use when entering plenum under compressed air, ventilation system, description of support erector and interface of EPBM with initial support system elements, tunnel spoil transport system and muck treatment facility if applicable.

- 2) Length and diameter of the tunnel drive(s), geologic conditions for the project.
- 3) If available, EPBM performance on similar projects describing ground surface settlement, average daily advance, average EPBM penetration rates and EPBM utilization.
- 4) The level of detail in the submittal shall be sufficient to demonstrate the EPBM(s) proposed for the Project operated and were successful in similar tunneling conditions.

E. Submit Action Submittals to include:

1. Submit the following to the ENGINEER and OWNER'S REPRESENTATIVE during construction within the specified time restrictions:

a. Daily submission of:

- 1) Shift reports.
- 2) Ring reports.
- 3) Settlement monitoring and instrumentation reports.
- 4) EPBM data logger data in real time electronic format.
- 5) Tail void proof grouting reports.
- 6) Soil samples and sampling report.
- 7) Air quality monitoring report.
- 8) Survey reports.

b. Weekly submission of:

- 1) Electrical inspection records.
- 2) Ventilation performance records.
- 3) Muck haulage records.

c. Monthly submission of:

- 1) Calibration report for gas detectors.

d. Event submission of:

- 1) EPBM maintenance report.
- 2) Lost ground reports.
- 3) Reports of combustible or toxic gas detection.
- 4) Notification and documentation of actual excavated volumes exceeding theoretical by more than 10 percent.
- 5) Report of emergency conditions and incidents.
- 6) EPBM outside line and grade tolerance window.
- 7) Inundation events.
- 8) Power loss.
- 9) Loss of communication.
- 10) Fire.

## 1.07 GENERAL REQUIREMENTS

- A. The CONTRACTOR shall construct the tunnel(s) in accordance with furnished design criteria to provide a complete, durable structurally sound, functional tunnel which meets the design intent set forth in these Contract Documents and provides for ease of maintenance and safety as specified in alternate sections of the Contract Documents.

- B. CONTRACTOR shall conduct all work necessary to complete the tunnel with the use of an EPBM for the Project where required. Elements of the Work shall include, but are not limited to, the following:
1. Provide an EPBM capable of excavating and supporting the ground. The CONTRACTOR and EPBM manufacturer will be responsible for the design of the total EPBM system. All back up equipment, auxiliary systems, support equipment, and other necessary for the sustained operation of the EPBM including, soil conditioning of muck material, water treatment and disposal systems, to meet the Project requirements as well as all jurisdictional requirements.
  2. Furnish and install a primary lining system while EPBM mining.
  3. Excavating, transporting and disposing of excavated materials, including contaminated materials, if they are encountered, in accordance with specifications.
  4. Furnish shield injection system capable of continuously filling the volume between the shield extrados and excavated surface to support the ground until grout is provided after the tail shield.
  5. Furnishing and placing backfill grout continuously and immediately after the tail shield to ensure the tail void volume between the precast concrete lining extrados and excavated surface is filled concurrently with the advance of the EPBM.
  6. Designing, furnishing and using conditioners, polymers, bentonite and/or other soil conditioning agents (conditioners) always and of types required to maintain soil plug and face stability, reduce wear, advance the heading, prevent clogging or sticking, and transport spoils in type of ground conditions encountered.
  7. Installation and maintenance of temporary drainage, lighting, power, water, fire suppression system(s), compressed air, and ventilation equipment.
  8. Furnish equipment and methods for drilling to check and verify complete filling of voids and stabilize and/or replacement of disturbed ground as required above the tunnel crown.
  9. Removing temporary bulkheads and support members and stabilizing ground at portals as required.
  10. EPBM assembly, launch, and recovery.
  11. Ensuring positive ground control during all stages of tunneling.
  12. Filling of excavation chamber behind cutterhead and pressurizing the face prior to mining.

## **PART 2 - PRODUCTS**

- A. Conditioners:
1. Shall be inert or biodegradable, accompanied by the manufacturers' certificate of compliance.
  2. NSF/ANSI Standard 60 clean water approved certified products or equal for clean water approval.
- B. Oil and Grease:
1. Flame resistant and biodegradable and accompanied by the manufacturers certificate of compliance, compatible with gasket material and protective liner, and in accordance with EPBM manufacturer recommendations.
- C. Tail Grout
1. Cement: in accordance with COSA Item 300 - Concrete.
  2. Portland cement will be in accordance with ASTM C150, Type II or Type III.
  3. Pozzolan (Fly ash): in accordance with COSA Item 300 - Concrete.
  4. Admixtures:
    - a. Accelerators, retarding agents shall be in accordance with ASTM C494.

- b. Admixtures and fluidizers that promote steel corrosion are not acceptable and shall not be used.
- c. Use admixtures compatible with proposed mixing water and contain no more than 0.1 percent chloride ion by weight of cement.
5. Water: in accordance with COSA Item 300 – Concrete.

### **PART 3 - EQUIPMENT**

- A. The EPBM shall be capable of excavating the tunnel and erecting initial lining while maintaining face stability and minimizing ground settlements in the geological conditions described in the Contract Documents.
- B. Earth Pressure Balance Machine (EPBM):
  1. General:
    - a. New, factory refurbished, or refurbished by an equivalent company who routinely performs EPBM refurbishment and is acceptable to the ENGINEER and OWNER'S REPRESENTATIVE.
    - b. Provide all ancillary equipment including trailing gear.
    - c. The EPBM shall be capable of excavating the tunnel and erecting the specified lining while maintaining face stability and minimizing ground loss in the geological conditions specified in the GBR.
    - d. Design the EPBM to be fully compatible with the initial lining.
    - e. Detailed operational procedures for EPBM including on site assembly, start up, testing, and launch activities.
  2. Cutterhead and Tools:
    - a. Design and configure the cutterhead with wear protection to enable excavation of the ground indicated in the contract documents:
      - 1) Cutting tool spacing shall be sufficient to permit excavation of the material at the tunnel face during tunnel launch, excavation, and reception.
      - 2) Cutting tools may include interchangeable disc cutters, picks, drag teeth and other cutting tools capable of cutting and removing materials as described in the GBR and GDR.
      - 3) Disc cutters shall be designed with adequate seals and bearings for performance in the range of conditions described.
      - 4) A combination of cutting tools may be required for efficient excavation of described ground conditions.
      - 5) Design the cutterhead to allow cutting tools to be replaced from the excavation chamber (back loading).
      - 6) Cutterhead shall be designed to prevent clogging in the ground conditions described in the GBR and GDR.
    - b. Diameter of excavated tunnel shall be overcut a maximum of 2-inches on the radius.
    - c. The CONTRACTOR should determine the need for abrasion protection based on values provided in the GBR and GDR.
    - d. Provide a wear detection system for both the cutterhead and a system for detecting wear on cutting tools.
  3. Cutterhead Drive System and Main Bearing:
    - a. CONTRACTOR shall provide EPBM with sufficient and adequate drive motor power to avoid torque limited performance while operating in any ground conditions described in the GBR and GDR.
    - b. A reversible, variable-speed cutterhead drive system with two speed ranges capable of starting at maximum torque.

- c. Certification from the main bearing manufacturer that the bearing is suitable for the geotechnical conditions indicated in the contract document and shall have a minimum bearing life of two times the anticipated operational hours.
  - d. Oil lubricated main bearing with pumping and filtration circuits equipped with accessible sampling points.
4. Face Support System:
- a. Design the EPBM to allow operator-controlled application of Active Face Support at all times, including:
    - 1) During EPBM advance or extended stoppage by earth paste.
    - 2) During inspection, maintenance, and boulder stops, per the CONTRACTOR's proposed inspection stop and EPBM maintenance plans.
    - 3) During Obstruction Stops use any means necessary to maintain face stability.
  - b. Measure support pressure with calibrated, abrasion resistant pressure sensors:
    - 1) Four earth pressure sensors within the excavation chamber: two sensors each near the crown and tunnel spring line and replaceable from the atmospheric side of the main bulkhead at any time.
    - 2) Sensor accuracy shall be consistent with required face pressure control tolerances.
5. Seals:
- a. The Main Drive sealing system shall incorporate the following:
    - 1) New main bearing seals designed to handle maximum anticipated support pressure.
  - b. The articulation joint seals shall incorporate the following:
    - 1) Designed for maximum hydrostatic head, earth pressure, and grouting pressure with a minimum safety factor of 1.25.
    - 2) Seals shall be monitored for pressure and volume of grease injection to ensure chambers are continuously full.
    - 3) Joint seals shall be replaceable from within the EPBM.
    - 4) Tail seal brushes and seal injection system shall be provided.
    - 5) Seals shall be fully packed prior to launch to prevent grout migration.
6. Propulsion and Steering System:
- a. Provide sufficient thrust to advance the shield under the maximum anticipated face pressure and shield friction.
  - b. Provide a propulsion system that can advance the EPBM under the combined maximum loads including, but not limited to: cutting tool loads, earth and hydrostatic pressure, shield friction, and trailing gear drag.
  - c. Provide propulsion cylinder extensometers at four positions separated by 90 degrees.
  - d. Ensure that maximum thrust contact pressure at any point and at any time on the Initial Lining shall not exceed 50 percent of the maximum permissible jacking load in the Initial Lining design.
  - e. Provide propulsion cylinder shoes or partial jacking rings as required to distribute thrust loads across the leading edge of the initial lining without developing eccentric loading on the ring for which the initial support was not designed.
  - f. Provide thrust cylinders which can provide individual actuation, synchronized actuation, and individual minimum and maximum thrust control. Thrust cylinders shall not permit displacements or bleed when idle or during shutdown. Provide support of thrust cylinders in a manner to preclude jamming during curve transitions and ensure thrust transmission remains perpendicular to the initial support.
7. Shield Articulation:
- a. EPBM and backup shall be designed to negotiate minimum radii horizontal and vertical curves of the alignment as well as meet required alignment tolerances.
  - b. Provide an active articulation joint fitted with hydraulic cylinders, or equivalent method, to permit the EPBM to follow the design line and grade.



- c. Provide sufficient injection ports around the circumference of the articulation joints such that cleaning or other operations can be easily carried out.
  - d. Provide extensometers at four positions on the active cylinders.
  - e. Provide passive articulation as required by the CONTRACTOR.
8. Drive System:
- a. CONTRACTOR shall provide EPBM with sufficient and adequate drive motor power to avoid torque limited performance while operating in any ground conditions described in the GBR.
  - b. Provide EPBM that can start cutterhead with at least 100 percent of rated full load torque. Provide clutches or hydraulic assist for variable frequency electric drive (VFD) or equipped with a variable speed hydraulic drive system.
  - c. Minimum design life for the main bearing shall not be less than ten thousand (10,000) hours based on L/10 life rating. Calculations shall be provided and include manufacturers recommended service criteria specific to EPBM operations.
  - d. EPBM cutterhead shall be bi-directional (reversing rotation) and be able to be operated equally in either mode.
9. Operator Position:
- a. Provide an ergonomic operator position which permits access to all controls, gauges and monitoring devices to permit safe operation of the EPBM.
  - b. Provide displays for Programmable Logic Controller (PLC) input/output and continuous guidance system monitoring.
10. Engineer's Position:
- a. Provide a position near the operator's console for the ENGINEER or OWNER's REPRESENTATIVE permitting an unobstructed view of excavation, grouting, and ring building activities, including access to the EPBM gauges and monitoring devices.
11. Muck Handling System:
- a. Muck handling components shall be designed for abrasion resistance, stickiness, clogging potential, and durability for the indicated ground conditions.
  - b. Muck handling system shall be cleaned, maintained, and coated, as required, to prevent clogging and sticking of muck which may cause issues with efficiency.
  - c. The ground conditioning system shall be sized and configured as required to form a homogeneous earth paste suitable for proper control of Required Support Pressure for all ground conditions indicated in the contract document. The system shall be computer controlled with interactive parameter setting at the operator position.
  - d. Fit the EPBM with a variable speed reversible screw conveyor to evacuate muck from the excavation chamber.
  - e. Locate the screw conveyor inlet at the bottom of the excavation chamber and equip the inlet with bulkhead doors designed to isolate the screw conveyor from the excavation chamber.
  - f. The screw outlet shall be fitted with a guillotine gate designed to operate and seal maximum hydrostatic and earth pressure in all soil types and water indicated.
  - g. Provide a positive displacement device fitted to the discharge end of the screw conveyor. This supplementary device shall be designed and sized to permit the controlled release of excessive pressure from the screw or excavation chamber. Muck pressure shall be reduced to atmospheric at the screw exit by proper ground conditioning, control of the screw conveyor and the provided pressure lock out device.
  - h. Equip the screw conveyor sleeve with a minimum of two pressure sensors; one located near the inlet and the other near the outlet.
  - i. Provide removable inspection hatches fitted with valves to permit access to mechanical linkages and for the removal of blockages which may occur within the screw.

- j. Provide ability for timely and efficient replacement of screw conveyor from within the tunnel. Primary belt conveyor(s) or alternate removal from the screw conveyor will not be acceptable.
  - k. Provide the equipment required to refill the excavation chamber.
  - l. Provide active mixing paddles, powered counter-rotating head, multiple mixing bars or other acceptable means within the chamber to condition material uniformly.
  - m. Provide accumulator with automatic valve which shall close the screw guillotine in the event of a power failure.
  - n. Provide equipment to measure both the weight and volume of excavated material during advance for each ring.
    - 1) Accuracy shall be within 1.0 percent of the measured units.
    - 2) Two independent methods shall be utilized to provide redundancy in the event one of the systems experiences a failure.
    - 3) Muck Control System shall be designed to assist the EPBM operator by comparing the theoretical excavated material relative to propulsion cylinder stroke to the actual excavated material at a given stroke length.
  - o. Conveyor Muck Removal System (if applicable):
    - 1) Conveyor muck removal system shall comply with all Federal, State, and Local Regulations and Laws.
    - 2) Conveyance systems shall be equipped with approved slippage switch systems (0 speed switch) to activate shut down should sliding friction occur between the belt drive(s) and the belt. The slippage switch system shall be inspected in accordance with the manufacturers recommendations and any regulatory agency guidelines. Most stringent regulation shall apply.
    - 3) Equip all conveyance systems with interlock capabilities which will shut down system when any belt in the system experiences reduction in speed or activation of any provided safety system.
    - 4) No combustible or metals materials shall be stored at a minimum one belt width of the installation. Machinery guarding shall be non-combustible material.
    - 5) Conveyor structures shall not have decks or platforms between the upper (troughing) and lower (return) belts. Structures of non-combustible materials may be located at transfer points, drive stations, and belt splicing facilities.
    - 6) Fire protection equipment shall be provided at head, tail, drive, and take up pulley locations. Fire suppression equipment shall also be provided at intervals not to exceed 300-feet along conveyors.
12. Support Erector:
- a. Support erector shall be designed as a rotary ring or arm type erector compatible with the EPBM, weight and dimension of each support element and system to ensure safe and efficient installation. A fail-safe system shall be installed to ensure system does not fail during a power loss.
  - b. Erector system shall provide power actuation in the axial, radial, and circumferential direction(s) and in the three articulation angles which correspond to freedom degree of the support. Erector shall be designed to grip and erect the support in a proper manner to ensure position placement(s) are accurate, true of shape, and support faces are planar, aligned with required tolerances and gaskets if used are fully compressed and no distortion or damage to support has occurred.
  - c. Positioning devices will be provided to indicate correct radial and circumferential location of the support within the tail shield. This equipment shall be capable of continuous measurement of the support gaps and tail shield. This data will be provided to the ring orientation computer program which shall be linked to the guidance system.

This system shall have available a computerized ring selection system to determine ring type and orientation.

- d. A computer program shall be provided to be linked to the EPBM guidance system to optimize support/curve alignment, check and correct ring planarity and circularity indicated for tolerances.
  - e. Erector shall be capable of disassembling the last fully erected support ring for allowance of inspection, repair, and replacement of wire brush seals.
13. Tail Grouting:
- a. Pumps, grouting and all ancillary tail grouting equipment shall be suitable for the selected EPBM configuration and grout mix.
  - b. The system shall be equipped with a volumetric measuring device accurate to 0.5 gallons and pressure gauges accurate to  $\pm 1$  psi over allowable grouting pressure range, and a scale device to continuously measure the weight of the grout reservoir.
  - c. The system shall be compatible, interlocked and dependent upon EPBM advancement.
  - d. The system shall allow for sampling by the Engineer at any time of: cement, cement grout mixture, grout additives or any other grout constituent both at the mixing plant and injection site prior to injection.
14. EPBM Guidance System:
- a. Provide EPBM with a computerized laser-theodolite based guidance system.
  - b. EPBM advance shall not be initiated without full operational function(s) of the guidance system
  - c. Provide details of all computer programs to be utilized for guidance system, ring orientation and parameters.
  - d. The system shall be capable of displaying the precise position and orientation of the EPBM in real time on a continuous basis with numerical and graphical display of horizontal and vertical deviation from the design line and grade.
  - e. Continuously monitor, record, and display:
    - 1) Date, time and tunnel station.
    - 2) Support ring, stationing values, as-driven coordinates and elevations, horizontal and vertical offsets from design line and grade.
    - 3) The number and orientation of tapered support rings required to achieve the desired alignment and the location of the axis of each ring relative to the axis of the tail shield.
  - f. Provide a comprehensive printout of displayed variables and messages that may be available on command or at designated intervals. Data shall be stored and recorded on a suitable device for later use and data to be delivered to the OWNER'S REPRESENTATIVE for upload into SAWS CPMS database.
15. EPBM Data Monitoring System:
- a. Provide system for real-time data monitoring and acquisition, storage and display system for:
    - 1) Propulsion cylinder stroke at a minimum of four positions. Pressure, average instantaneous advance rate and total thrust shall be shown for all cylinders.
    - 2) Extensions of propulsion and active/passive articulation cylinders at a minimum of four positions, pressure and total thrust.
    - 3) Cutterhead rpm, direction and torque.
    - 4) Electric motor status and power consumption.
    - 5) Main bearing and main bearing sealing system oil pressure, temperature and flow.
    - 6) Data from the EPBM Guidance System.
    - 7) Face support pressure.
    - 8) Air flow for breathing air.
    - 9) Muck Control System data.

- 10) Ground conditioning system data including water, polymer and foam solution flows and pressure, air flows and pressure, Foam Injection Ratio (FIR) and Foam Expansion Ratio (FER) for each individual line.
  - 11) Discharge system from excavation chamber including stone crusher and screw conveyor rotation speed and guillotine gate position indication.
  - 12) Bulkhead valve status.
  - 13) All gases included in the gas detection and monitoring system.
  - 14) Pressures and volumes of tail grouting and volume of tail seal grease.
  - b. Record data at maximum time intervals of ten seconds and display in real-time at:
    - 1) EPBM operator's position.
    - 2) At the CONTRACTOR's Site office.
  - c. Store and record data via an automated acquisition system in digital form for later use and retrieval.
  - d. Provide secure Internet-based access to real time data for use by the OWNER'S REPRESENTATIVE in the OWNER'S REPRESENTATIVE's office.
  - e. Maintain hardware necessary for recording and real time viewing of data at the Site. In the event of downtime due to hardware within the CONTRACTOR's control, notify the OWNER'S REPRESENTATIVE of the issue, repair hardware, and restore Internet-based access to real time data within 48 hours of hardware failure. Maintain recording of data at all times.
16. Spare Parts Inventory:
- a. At a minimum, provide spare parts recommended by the Manufacturer needed for the duration of EPBM excavation. The CONTRACTOR shall supplement the spare parts to effectively and efficiently excavate the ground to meet the schedule.
  - b. A spare main bearing assembly and associated seals, and main drive gear shall be available at the site within 10 days and must be certified as either new or as new condition by the EPBM manufacturer.
  - c. The CONTRACTOR shall maintain an inventory of spare parts recommended by the equipment manufacturer and backup systems manufacturers or other equipment manufacturer as required for CONTRACTOR's operations. The CONTRACTOR shall provide maintenance and parts replacement services for all equipment to minimize unscheduled down time leading to delay in tunnel advance.
17. Tunnel Systems and Plant:
- a. All hoses, seals, electrical components, mechanical components, and conditioning systems can remain operational under exposure to water and soil.
  - b. Communications Systems:
    - 1) Provide hard wired telephone communication system at all times, including emergencies, from the EPBM, along the tunnel alignment at maximum intervals of 250-feet, at California switches (as applicable), at the shaft bottom, and at ground surface.
    - 2) Wireless communication system on locomotives linked with portal bottom and EPBM.
  - c. Materials Handling for Working in the Excavation Chamber:
    - 1) Provide appropriate materials handling equipment to permit the safe passage of excavation tools and other materials from the end of the support feeder into the excavation chamber.
  - d. Electrical System:
    - 1) The EPBM and trailing gear electrical systems shall be designed according to the requirements of OSHA 1910.399 for Class 1 Division 2 locations and all other requirements of OSHA or other applicable regulatory agencies.

- 2) The primary power distribution system shall have means for eliminating high-voltage fluctuations when starting up or shutting down the EPBM.
  - 3) The electric system shall incorporate an emergency standby generator with a capacity and configuration to automatically come on-line in the event of a power failure to operate ventilation, lighting, pumping, communications, air compressors and other systems without interruption.
  - 4) A power interrupt that shall automatically shut down power to the EPBM and trailing equipment upon detection of an air quality event such as explosive or toxic gas levels exceeding the regulation limits, while maintaining power to ventilation, emergency lighting, de-watering pumps, and safety support systems.
- e. Lighting Systems:
- 1) Provide a primary lighting system for the entire length of the tunnel.
  - 2) Additional lighting in tunnel shall be implemented for inspection of construction operations by the ENGINEER or OWNER's REPRESENTATIVE.
  - 3) All flashlights shall be approved by MSHA as "permissible".
  - 4) The use of flame safety lamps is prohibited.
- f. Water Pumping in Tunnel:
- 1) In accordance with Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels.
  - 2) Pumping capacity at the excavation chamber and EPBM as required to remove accumulations of water from construction discharges and any groundwater inflows at the heading or through shield articulations or wire brush seals.
  - 3) Provide intermediate pumping stations and pumping capacity along the tunnel as required to remove water accumulations from construction discharges and any groundwater seepage and to maintain accumulated water levels below tunnel railheads.
  - 4) Provide detailed description of water handling and disposal in tunnel.
- g. Transportation System:
- 1) Provide for the transportation of material, supplies, persons, and injured persons with consideration of higher tunnel gradients at California switches and ramps.
  - 2) Locomotives shall conform to the requirements of MSHA 30 CFR 36 no matter the classification of the tunnel.
- h. Ventilation System:
- 1) Shall meet all OSHA regulatory requirements for potentially gassy operations and additional requirements of this Section.
  - 2) Shall be fully reversible with ability to meet all performance and air quality criteria in exhaust or intake mode.
  - 3) Ventilation duct shall be made of non-combustible materials.
  - 4) Locate exhaust stacks of the ventilation system to prevent recirculation of exhaust air into the air intake shaft or portal.
  - 5) Design:
    - a) Meet or exceed minimums required by OSHA.
    - b) When the tunnel or other underground excavations are occupied, the primary ventilation system shall deliver fresh air to the heading at a volumetric flow rate of at least 90-feet per minute multiplied by the excavation cross section measured in square feet.
    - c) Configure and operate fans to minimize recirculation of air in the EPBM.
    - d) Where the ventilation system in the EPBM is operating in an exhaust mode, ventilation shall be provided by a supplementary fan positioned to minimize recirculation.

- e) Provide additional equipment for ventilation of confined areas of the EPBM not reached by the ventilation system.
- 6) Power to the primary ventilation system shall not be interrupted in the event of a gas detection system alarm.
- 7) The primary ventilation and booster fans for tunnel ventilation and related electrical equipment and cables located within the tunnel or portals shall be approved for use in Class 1 Division 2 hazardous locations as defined by OSHA 1910.307.
- i. Health and Safety Equipment:
  - 1) In addition to the health and safety requirements listed in this section, features for equipment used in tunneling work shall meet the following requirements:
    - a) Equip EPBM with integrated safety systems in accordance with applicable regulatory requirements for underground construction equipment.
    - b) All equipment shall be rated for use in Class 1 Division 2 hazardous locations as required by OSHA 1910.399.
  - 2) Minimum Fire Protection Requirements:
    - a) Provide fire suppression systems within EPBM and along trailing gear for all electro-hydraulic installations, heat sources, and the EPBM transformer.
    - b) Provide a clear emergency escape way from the EPBM along the trailing gear.
    - c) Provide fire suppression system on all locomotives.
    - d) Provide fire extinguishers at the EPBM control pan at 25-foot intervals along the trailing gear.
    - e) Provide a water curtain at the rear end of the trailing gear.
  - 3) Air Quality Monitoring:
    - a) Provide an air quality monitoring and alarm system to monitor combustible gas and airborne particulate concentrations in the tunnel atmosphere.
    - b) Design the alarm system to de-energize the EPBM at no more than 20 percent of lower explosive limit (LEL) for methane or any other combustible gas.
    - c) Position sensors at locations that provide the most effective measurement of combustible and toxic gases. Do not place sensors within a fresh air stream.

#### **PART 4 - EXECUTION**

##### **A. EPBM -General Requirements**

- 1. Do not begin tunneling until the following tasks have been completed:
  - a. Required Submittals have been provided in accordance with Section SS 01300 – Submittals and reviewed by the ENGINEER and OWNER'S REPRESENTATIVE.
  - b. Locations and elevations of shafts have been surveyed to confirm that Work can be completed in accordance with alignment and grade shown on Drawings.
  - c. All instruments per Section SS 01520 – Geotechnical Instrumentation and Monitoring have been installed and baseline measurements established.
  - d. The complete EPBM and trailing gear shall be Factory Tested prior to shipment to Site. Upon reassembly at Site, the EPBM shall be re-tested and all components re-calibrated. The OWNER and the OWNERS REPRESENTATIVE shall reserve the right to be present and observe/witness testing which may include major EPBM assemblies.
  - e. The Ground Conditioning System (GCS) shall be tested such that all functions are within the manufacturer's recommendations prior to the EPBM delivery.
  - f. Site Safety Representative has prepared a code of safe practices and an emergency plan in accordance with OSHA and other applicable requirements. Provide the OWNER's REPRESENTATIVE with a copy of each prior to starting tunneling. Hold safety meetings and provide safety instruction for new employees as required by OSHA.

Conduct a pre-construction safety conference in accordance with OSHA requirements. Arrange this conference and inform the OWNER'S REPRESENTATIVE of the time and place of the conference at least seven days in advance.

- g. Properly manage and dispose of groundwater or surface water inflows to the shafts. Discharge groundwater inflows in accordance with an approved discharge permit.

**B. EPBM Operations:**

1. Complete the EPBM tunneling in accordance with reviewed Submittals, and applicable permit conditions.
2. Transport initial lining from storage to the erector without damage. Transport methods shall be acceptable to initial lining manufacturer. Do not use damaged initial lining in the Work, unless permitted in writing by the ENGINEER.
3. Do not exceed the specified allowable stresses on the erected initial lining.
4. Control ground settlement and heave above the alignment to prevent damage to existing utilities, facilities, and improvements. Repair damage resulting from construction activities. Pressure grout voids caused by or encountered during shaft construction and tunneling. Modify equipment and procedures as required to avoid recurrence of excessive settlements or damage.
5. Completely contain, transport, and dispose of excavated materials and fluid additives and lubricants away from the site. Contain spoils in trucks or other containers. Dumping of spoil on the ground, discharge into sewers or ditches, or discharge into the shafts is not permitted. Manifest each truck load containing spoils, to include contents of truck load and disposal location.
6. After erection of a complete ring, fill the annular space created by the radial overcut of the machine with grout, in accordance with reviewed Submittals.

**C. Control of Line and Grade:**

1. Establish, protect and utilize benchmarks as defined in Section SS 02410 – General Tunneling Requirements.

**D. Installation of Pipe**

1. Install carrier pipe within the casing and backfill annular space between the casing and carrier in accordance with Section SS 02430 – Installation of Pipe in Tunnel and Section SS 02431 – Annular Backfill for Carrier Pipe.

**PART 5 - MEASUREMENT AND PAYMENT**

No separate measurement or payment will be made for work described under this item. All items associated with this section will be in addition to items under Section SS 02410 – General Tunnel Requirements.

**END OF SECTION**

## **PART 1 - GENERAL**

### 1.01 SCOPE OF WORK

- A. The work specified in this Section includes requirements for design, fabrication, storing, transporting and erection of bolted and doweled, gasketed precast concrete segments as the initial and final water-tight tunnel lining for the earth pressure balance machine (EPBM) excavated tunnel. The segments shall allow for rapid erection within the earth pressure balance machine, and shall resist loads imposed during manufacture, handling, transport, and installation. Also included are the repair of segment defects and the filling of grout holes and lifting holes.

### 1.02 RELATED WORK

- A. Section SS 01510 – Pre and Post-Construction Inspections
- B. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- C. Section SS 02410 – General Tunneling Requirements
- D. Section SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM)
- E. Section SS 02412 – Tunneling with Non-Pressurized Shielded TBM
- F. Section SS 02413 – Hand Mining
- G. Section SS 02420 – Steel Liner Plate
- H. Section SS 02422 – Shotcrete
- I. Section SS 02430 – Installation of Pipe in Tunnel
- J. Section SS 02431 – Annular Backfill for Carrier Pipe
- K. Section SS 02432 – Contact Grouting
- L. Section SS 02440 – General Shaft Requirements
- M. Section SS 02441 – Secant Pile Walls
- N. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. American Concrete Institute (ACI).
  - 1. ACI 347 – Guide to Formwork for Concrete.
  - 2. ACI 350 – Code Requirements for Environmental Engineering Concrete Structures.
  - 3. ACI 544.7R – Report on Design and Construction of Fiber-Reinforced Precast Concrete Tunnel Segments.
- B. American Society for Testing and Materials (ASTM).
  - 1. ASTM A108 – Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.



2. ASTM A123 – Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  3. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  4. ASTM A325 – Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  5. ASTM A490 – Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
  6. ASTM A820 – Standard Specification for Steel Fibers for Fiber-Reinforced Concrete
  7. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
  8. ASTM D395 – Standard Test Methods for Rubber Property-Compression Set.
  9. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
  10. ASTM D518 – Standard Test Method for Rubber Deterioration-Surface Cracking.
  11. ASTM D1149 – 07 Standard Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment.
  12. ASTM D2240 – Standard Test Method for Rubber Property - Durometer Hardness.
  13. ASTM D6048 – Standard Practice for Stress Relaxation Testing of Raw Rubber, Unvulcanized Rubber Components, and Thermoplastic Elastomers.
- C. RILEM
1. RILEM TC 162-TDF – Test and Design Methods for Steel Fiber Reinforced Concrete.

#### 1.04 DEFINITIONS

- A. Refer to Section SS 02410– General Tunneling Requirements for additional definitions.
- B. Annular Space: Void between the external face of the lining and the ground.
- C. Bolted, Gasketed Precast Concrete Segments: Initial structural support system designed for specified loads and comprising bolted and doweled, gasketed, precast concrete segments erected as a ring within the EPBM tail shield, and against which the machine thrusts in order to perform tunnel excavation.
- D. Circumferential Joints: Joints between adjacent segment rings, perpendicular to the direction of the tunnel.
- E. Extrados: Exterior circumferential surface.
- F. Gap: The distance between load-bearing surfaces of precast segments at longitudinal or circumferential joints. The gap distance is dependent on the thickness of the packing, the magnitude of the compression forces acting upon the segment joint, the amount of gasket compression and depth of gasket groove. Gap is used as a measure of initial loading of gaskets during precast lining erection and is an indicator of the ability of the gaskets to seal the segmental lining joints to prevent groundwater leakage.
- G. Gasket: a mechanical seal that fills the space between two segments to prevent leakage at the joints while under compression.
- H. Intrados: Interior circumferential surface.

- I. Longitudinal Joints: Joints between adjacent segments within a ring, parallel to the direction of the tunnel.
- J. Packing: Load-distributing elements cut to the geometries of the longitudinal or circumferential joints in which they are placed. The term "packing" does not mean "shimming" as used herein.
- K. Shim: Strip of material applied at joints to provide minor adjustments to the planarity of the joint, or to make minor corrections to line and grade. Shims shall only be allowed for circumferential joints in accordance with the requirements specified herein.
- L. Tail Void Grouting: Grout injection to fill the annular space.

#### 1.05 GROUND CONDITIONS

- A. The work will be performed through subsurface conditions which have been investigated for the purpose of developing assumptions about ground conditions. Both a Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR) have been prepared based on this information.
- B. The primary objective of the GDR is to present the results of geotechnical investigations conducted for the project in a factual manner. These results include descriptions of field and laboratory investigations performed and procedures used, background physiography and regional geology information, and summaries of site subsurface conditions.
- C. The primary objectives of the GBR are to present the ENGINEER's interpretation of subsurface conditions and ground behavior, to present the basis of geotechnical design, to describe how these conditions might affect tunnel construction, and to present the geotechnical "baseline" for design that will be the basis for bidding, and resolution of potential differing site conditions with respect to the occurrence of different ground types and ground water anticipated for the work.

#### 1.06 QUALITY ASSURANCE AND QUALITY CONTROL

- A. All quality control testing associated with manufacture of precast concrete segments is the responsibility of the CONTRACTOR.
- B. Qualifications:
  - 1. Segment Manufacturer: A qualified firm regularly engaged in the manufacture and fabrication of precision bolted, gasketed precast concrete tunnel lining segments of similar dimensions and tolerances to those specified, and who has provided precision tunnel rings in the last five (5) years for at least three large public projects comparable to the work of this Contract in size and type.
    - a. Segment Manufacturer will employ personnel fully qualified and experienced in the manufacture of precision, bolted, gasketed precast concrete tunnel lining segments. Lead personnel shall have a minimum of 10 years of experience on similar projects.
  - 2. Gasket manufacturer: Shall have a minimum of 10 years of experience and shall demonstrate that gaskets with the same profile have performed successfully in similar tunneling applications.
  - 3. Segment Designer: Registered Professional Engineer Licensed with a minimum of 5 years of design experience in underground construction and in the design of precision bolted, gasketed precast concrete segments used as a final lining.
  - 4. Test Laboratory: Initial Testing to be performed by an independent materials testing laboratory with a minimum of five (5) years experience testing the materials of the type and

for the purpose specified herein. Production testing may be performed by the Segment Manufacturer with qualified personnel and approved laboratory equipment and processes for testing the materials of the type and for the purpose specified herein.

C. Testing:

1. Allow the ENGINEER and OWNER's REPRESENTATIVE access to work area and provide space, workers, and equipment for performing testing and inspections.
2. Provide equipment including master and working templates, gauges, and calipers adequate to determine accuracy and tolerances in manufacturing.
3. Provide certified testing, by a qualified independent laboratory, satisfactorily demonstrating in embedded conditions the following:
  - a. Minimum (yield) pullout and shear capacity on circumferential joint connector assemblies.
  - b. Minimum (yield) pullout and shear capacity on bolt anchorages.
4. Perform gasket tests of type required and recommended by gasket manufacturer to demonstrate compatibility with the temporary support design and expected ground conditions defined in the GBR.
  - a. Testing shall include the following:
    - 1) Water tightness tests.
    - 2) Reaction load tests.
    - 3) Gasket line load tests.
    - 4) Stress relaxation tests in accordance with ASTM D6048.
5. Perform trial mix and production concrete testing in accordance with COSA Item 300 – Concrete.

D. Source Quality Control

1. Segment Identification:
  - a. Cast the segment type and mold identification directly on the segment intrados.
  - b. Paint the casting date adjacent to the above-cast information.
2. Quality Control:
  - a. Mockup or Ring Fit-Up:
    - 1) Prior to beginning production fabrication of the precast concrete segments, completely assemble and survey two rings of each different segment ring combination cast from proposed molds, packing, and connections. If only tapered rings are proposed, only one set of two segment rings shall be required. If tapered and straight rings are used, assemble sets of two rings to mockup a taper-taper, taper-straight, and straight-straight assembly.
      - a) Assemble each set of rings separately at the place of manufacture by stacking segment rings one on top of another on a level, flat surface with joints staggered.
      - b) Survey the rings to verify that the segments as cast meet specified fabrication and erection tolerances including inner diameter and joint offsets.
      - c) Adjust or replace forms as required to meet specified requirements.
3. The ENGINEER will select the bottom ring from each of the sets to be retained as the master ring for the duration of segment casting operations to verify compliance with fabrication tolerances for the production segments using the same 2-ring configuration.
  - a. Select segments for the upper trial ring in accordance with the following:
    - 1) Non-tapered segments: Every 500th segment cast from each mold.
    - 2) Tapered segments: Every 250th segment cast from each mold.
    - 3) Mold repair or replacement: First segment ring cast.

- b. Survey the segment rings to verify that the molds and segments meet specified fabrication and erection tolerances.
  - 1) Maintain one test ring as a master ring to ensure that tolerances are being maintained where specified.
  - 2) Demonstrate lining tolerances are as follows:
    - a) Circumference of outside face of assembled ring as measured by a steel tape is within +/- 1.5 inch of the theoretical outside circumference, equal to 3.1416 times the outside diameter of the ring.
    - b) Inside diameter of the assembled ring as measured by a steel tape is within +/- 0.5 inch of the theoretical inside diameter.
  - 3) Start production of segments only after obtaining the Engineer's written acceptance of the mockup liner.
- c. Adjust or replace forms as required to meet specified requirements.
- d. The ENGINEER may elect to reduce the frequency of these ring fit-ups if performance requirements are consistently met.

**E. Field Quality Control**

1. Establish a program for measuring the deformation of the lining system under load:
  - a. Install four anchors at 90-degree spacing at every 25th segment ring for tape extensometer measurement.
  - b. Measure deformations and compare to previously recorded measurements.
  - c. Measure deformations on a bi-weekly basis for damaged rings or rings exhibiting excessive squat as directed by the OWNER's REPRESENTATIVE.
  - d. The OWNER's REPRESENTATIVE may reduce the frequency of measurements if no movement greater than 0.1-inches is detected in the first four readings. Measurements may be stopped if this trend continues for another four readings.
2. Inspect the conditions and the competence of segmental lining:
  - a. Daily, where installed.
  - b. Immediately after each shove of the EPBM.
  - c. During and upon completion of tail void grouting.
3. Perform an as-built survey of installed segment rings for verifying the segmental lining installation in accordance with specified tolerances:
  - a. Record measurements at the crown, invert, and springline, totaling four locations at every 5th segment ring.
  - b. Maintain the survey no less than 1,500 feet and no greater than 2,500 feet behind completed tail void grouting operations.

**1.07 SUBMITTALS**

- A. All submittals shall be in conformance with Section SS 01300 – Submittals.
- B. Integrate submittal information as appropriate with submittal requirements specified in Section SS 02411 - Tunneling with an Earth Pressure Balance Machine (EPBM).
- C. Submit Informational Submittals to include:
  1. Qualifications:
    - a. Within 12 weeks of notice to proceed (NTP), submit the names and segmental lining manufacturing experience of personnel responsible for overall segment casting operations and for those managing day-to-day casting operations and quality control at the precast concrete plant.

2. The CONTRACTOR shall submit the following documentation to the ENGINEER at least 12 weeks prior to the commencement of precast concrete tunnel lining segment production:
  - a. General: CONTRACTOR shop drawings, working drawings, calculations, and quality control plans and procedures shall be stamped and signed by the Segment Designer.
  - b. Method statements and Quality Control Procedures: Details shall address all stages of the material supply, manufacturing, shipping and repair.
  - c. Shop Drawings:
    - 1) For each type of segment, showing details of mechanical joint connection assemblies, stress relief grooves, shear connectors, gasket grooves and gaskets, bolts with hardware and bolt inserts, dowels and dowel inserts, guide rods, packer positioning, and vacuum lifting shear pockets. No segments shall be cast until shop drawing submittals are reviewed.
  - d. Product data for gaskets, bolts and hardware, dowels and hardware, packers, guide rods, foam strips, and adhesives.
  - e. Details of proposed precast concreting molds.
  - f. Working Drawings and Methods Statements:
    - 1) Physical description and properties the precast concrete segment lining design, including details, dimensions and supporting design calculations demonstrating compliance with specified performance criteria. Calculations shall comply with the followings:
      - a) Include all load cases as specified herein.
      - b) Include the handling, storage and installation load cases, in addition to the joint loading and reinforcement details for the applied loads (EPBM, ground, and all loads specified herein).
      - c) Design of the gasket groove for the selected gasket.
      - d) Structural calculations specifying minimum compressive strengths when segments may be stripped from molds, handled, stacked, transported, and erected.
      - e) Structural calculations shall be stamped by the segment designer.
    - 2) Drawings showing layout facilities for casting, curing, stacking, and storing segments.
    - 3) A detailed description of procedures for fabricating, handling, transporting, and storing segments, including calculations of stresses during handling.
    - 4) A detailed description of transporting segments into the tunnel, systematic description of sequence for erecting and fastening segments, and placing segment backfill grout.
    - 5) Details of Segment Repair and Patching, comprising:
      - a) Detailed procedure for process of repairing segments during fabrication and during installation of tunnel lining.
    - 6) Details for packing incorporated into the longitudinal and circumferential joint surfaces between segments. Include type of material, thickness, compressibility, calculations and test results demonstrating compliance with design criteria specified herein.
  - g. Methods, procedures and details of the curing process from segment casting to 28 days after casting, with test data including temperature gradient measurements from trial segments to verify that curing requirements can be achieved.
  - h. Samples: Two samples each of joint connection assemblies, joint gasket material, bolts with hardware, bolt inserts, dowels, dowel inserts, packers, foam strips, and guide rods.
  - i. Certifications:
    - 1) Provide written certification from the precast concrete segment manufacturer of full and complete design coordination between the EPBM manufacturer and the precast

concrete segment manufacturer. Include a written certification by both manufacturers affirming the compatibility of the EPBM and the liner system.

- 2) Certificates of Compliance for materials specified in Part 2 herein.
  - 3) By segment manufacturer, that precast concrete segments meet minimum fabrication criteria specified.
  - 4) CONTRACTOR must demonstrate that the manufacturer has certified its foreman or superintendent to install concrete segments.
  - 5) Separately by CONTRACTOR and segment manufacturer that precast concrete segments are capable of accommodating storage, transportation, handling, erection, and EPBM thrust loads.
  - 6) By CONTRACTOR that the circularity tolerance specified is adequate based on the CONTRACTOR's proposed segment configuration and geometry.
- j. Quality Control Plans:
- 1) Segment Fabrication:
    - a) Methods for measuring and assuring that specified tolerances are met with due consideration for thermal, moisture, and ambient temperature influences.
    - b) Include methods for testing and sampling to verify minimum required compressive strength before stripping.
    - c) Methods for controlling shrinkage and temperature cracking.
    - d) Record keeping and procedures for resolving quality defects.
  - 2) Segment Protection: Methods for protecting segments and appurtenances from damage while handling, transporting, storing, and installing.
  - 3) Segment Ring Mockups:
    - a) Measurements assuring compliance with specified and submitted tolerances and segment interchangeability requirements.
  - 4) Segment Erection:
    - a) Methods for maintaining circularity and position of segment rings within specified limits.
    - b) Contingency plan addressing excessive deformation of segment rings.
    - c) Methods for assuring compliance with specified limits for leakage.
  - 5) Segment Performance:
    - a) Methods for measuring segment ring deformation and position.
    - b) Methods for measuring water inflows both collectively and individually.
    - c) Methods for demonstrating conformance of gasket material to specified design criteria.
  - 6) Segment Remedial Work:
    - a) Segment repair and rejection criteria.
    - b) Proposed methods of repairs for damage within allowed parameters.
  - 7) Proposed methods to:
    - a) Correct misaligned segments and gaskets.
    - b) Support and repair structurally damaged segments after installation.
    - c) Seal leaks to achieve specified leakage criteria limits.

D. Submit Action Submittals to include:

1. Record keeping during tunnel excavation and segment erection. Integrate this information with requirements specified in Section SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM):
  - a. Daily:
    - 1) Segment Ring information:
      - a) Sequentially numbered accounting of segment rings erected in the tunnel correlated to tunnel station.

- b) Segment type and ring orientation.
- c) Measurements of segment ring eccentricity with respect to the tail shield.
- d) Measurements of segment ring roll.
- e) Measurements of segment ring circularity.
- f) Notations of segment damage.
- g) Rate of advancing each ring.
- 2) Water flow measurements, with contribution from CONTRACTOR construction water:
  - a) At individual sources. Include the stationing.
  - b) Cumulative flow
- b. Weekly:
  - 1) Perform measurements of tunnel rings in accordance with Field Quality Control defined herein.
- c. Bi-Weekly:
  - 1) Water flow measurements at individual sources after first week of installation.
  - 2) Measurement of segment ring deformation by location correlated with previous measurements.
- d. Notifications:
  - 1) 15 days in advance of assembling demonstration segment rings.
  - 2) Within 1 day of removing a segment casting mold from service for repair or replacement. Provide survey results to verify conformance of repaired or replacement mold to tolerance requirements. In cases of repair, additionally submit written report including the nature of the damage and the method of repair.
  - 3) Immediately, upon discovering precast segments that do not conform to the requirements of the CONTRACTOR's design and the minimum design requirements set forth herein, and promptly rectify the non-conformance.
- E. Submit Closeout Submittals to include:
  - 1. As-Built Data:
    - a. Surveys of tunnel in accordance with Field Quality Control.

#### 1.08 GENERAL REQUIREMENTS

- A. Concrete segments and associated items shall be designed by the CONTRACTOR for anticipated ground and water loads and environmental conditions on the completed tunnel. The CONTRACTOR shall ensure that the segments are compatible with their selected construction equipment, means, methods, and procedures including, but not limited to, handling, erecting, jacking, and grouting. The CONTRACTOR shall submit all segment design documentation required to ensure this compatibility and include all costs related to such modifications in the bid price.
- B. Ensure that segment production schedule does not conflict with and is adequate for anticipated tunnel excavation rates.
- C. Performance Requirements
  - 1. Furnish a segmental precast concrete lining system, produced to the specified tolerances, capable of:
    - a. Rapid erection within the EPBM.
    - b. Providing a watertight barrier when erected with gasket alignments within the tested range of displacements as specified in this Section.
    - c. Resisting loads imposed during manufacturing, handling, storage, and transport.

2. The tunnel liner shall be designed for all penetrations and connections at the shafts.
  3. Protect precast concrete segments against damage at all times during production, handling, transportation, delivery, storage, and installation.
  4. Protect in-place precast concrete segmental tunnel lining against damage at all times during construction, including the post-installation period.
- D. Design Criteria:
1. The precast concrete segments are intended to provide initial support for the tunnel during excavation. The precast concrete segments are relied on for temporary support providing thrust and moment capacity for ground, structure, grouting, and groundwater loads.
  2. Concrete segments, gaskets, bolts, dowels, and associated items shall be designed for the anticipated environmental conditions, ground, groundwater and other anticipated loads on the tunnel until the complete installation and annular backfilling of the carrier pipe.
  3. The CONTRACTOR shall design the segments to be compatible with the CONTRACTOR's means and methods and to meet the following requirements:
    - a. Base design on ACI 544.7R – Report on Design and Construction of Fiber-Reinforced Precast Concrete Tunnel Segments.
    - b. Size segments to allow for their fabrication, handling, erection, and to withstand EPBM jacking forces.
    - c. Provide chamfers for all corners to reduce stress concentrations as necessary.
    - d. Joint Surfaces: Form a flat plane (with exception of gasket groove).
      - a) Joint Planes: Perpendicular to plane of segment, except for tapered or key segments.
    - e. The CONTRACTOR shall design and select lifting devices for the segments that will be compatible with the CONTRACTOR's proposed segment lifting, handling, and erection equipment. Special reinforcement may be required if segments are handled at early age.
    - f. The CONTRACTOR shall design the precast concrete lining system to achieve the alignment shown on the plans, and shall provide for curves in the alignment, and for making adjustments to maintain line and grade, by use of tapered rings. Tapered rings to be used for constructing the curved alignment shall be capable of achieving a radius equal to or less than 1/2 of the minimum design alignment radius to correct any deviation from the design alignment. The CONTRACTOR shall install the tapered segments as required to maintain segment leading face at 90 degrees to alignment. Line and grade tolerances during tunnel excavation shall be in accordance with Section SS 02410 -General Tunneling Requirements.
  - g. Design Loads:
    - 1) Ground and Groundwater Loads (including swell pressure): In accordance with the Geotechnical Baseline Report (GBR).
    - 2) All construction-imposed loads, including, but not limited to, the following:
      - a) Manufacturing, handling, and storage loads.
      - b) Erection and jacking forces.
      - c) Loads across joint connections and along circumference, to maintain joint and installation performance.
      - d) Invert loads along the longitudinal axis of the tunnel derived from transport of equipment and materials.
      - e) Loads generated by grouting, handling, erection, and the tunnel boring machine.
    - 3) Other Loads:
      - a) Design for the loadings and pressures from tail void grouting and contact-grouting.
      - b) Design for eccentric load distribution both in radial and circumferential joints arising from tolerances, deformations, or any other cause.
      - c) Design segmental ring for an angular distortion due to ovaling or racking.



- 4) Design segment joints to accommodate a gasket groove for the required gasket width and with minimum clearances between:
  - a) The segment extrados and the outer edge of the gasket groove to prevent spalling of the concrete due to required gasket line loads.
  - b) The joint packing and the inside edge of the gasket groove to prevent damage to the gasket when the packing is compressed, all while maintaining:
    - i) The required maximum limit of the segment gap width.
    - ii) The required dimensions of the packing relative to the segment joint.
4. Gasket: Design for the pressure and leakage criteria specified herein. Coordinate packing thickness with the gasket system design to assure specified performance.
  - a. Provide waterproofing gaskets on all mating faces.
  - b. Provide gasket capable of handling no less than the higher of:
    - 1) 150 percent of the maximum tail void grouting pressure.
    - 2) 150 percent of the maximum anticipated hydrostatic pressure.
  - c. Coordinate design of the gasket system with the gasket properties and the gasket groove depth to achieve the required results over the range of gap widths established in the structural design.
  - d. Capable of fulfilling the above-specified requirements when subject to offsets and gaps commensurate with the allowable erection tolerances.
  - e. Select durable gasket that residual contact pressure between the gasket surfaces is capable of resisting the environmental conditions indicated in Contract Documents.
5. Segment Joints:
  - a. Provide joint connection assemblies to facilitate structural performance, ring circularity, and to assist in ring stabilization.
  - b. Furnish doweled mechanical joint assembly system for circumferential joints. Provide a minimum of two (2) dowel assemblies for each radial joint connection.
  - c. Loads across joint connections, and along the circumference, to maintain joint and installation performance and to invert loads along longitudinal axis of the tunnel derived from the transport of equipment and materials, and loads generated by grouting, handling, erection, and the tunnel boring machines are the CONTRACTOR's responsibility.
  - d. Design segment joints to withstand forces caused by compression of the gasket, without cracking or fracturing.
  - e. Provide compression packing on circumferential joint faces.
  - f. Longitudinal joints shall be planar.
6. Bolted Connections:
  - a. Design bolted, doweled, or other positively interlocking mechanical connections between segment panels. Longitudinal joints shall be connected by bolts only.
  - b. Minimum of two connections at each joint face for each segment except at circumferential joints for key taper segments which may utilize a single connection.
  - c. Design connections to maintain adjacent gaskets sufficiently compressed to perform in accordance with specified requirements.
  - d. Design bolt pockets for bursting.
7. Packing:
  - a. The joints shall be designed to allow sufficient closure of the gaskets to assure sealing against design pressures with compression packing in place. The packing shall distribute compressive stresses across the segment joint without affecting the ability of the segment gasket to withstand existing hydrostatic pressures.
8. Shimming:
  - a. Prohibited at all longitudinal joints.

- b. Shimming in the circumferential joint is only permitted to the extent that sealing capability of the gaskets is maintained.
      - c. Prohibited from being used as primary means to negotiate curves.
    - 9. Grout ports:
      - a. Provide a minimum of one grout port per segment.
      - b. Equip with a threaded sleeve and cap.
      - c. Design to prevent damage to segments during grouting.
      - d. Design the grout cap seal and insert body to withstand the same hydrostatic load conditions applied to the gaskets specified herein.
    - 10. Fabrication Requirements:
      - a. Cast concrete in a controlled environment protected against rain, dust and direct sunlight.
  - E. Tolerances:
    - 1. Fabrication:
      - a. Manufacture similar segments with such accuracy and uniformity in dimensions that the segment panels of the same type are interchangeable from segment ring to segment ring. This requirement applies separately to tapered and non-tapered segments.
      - b. Use tolerances necessary for erection and water tightness.
    - 2. Erection:
      - a. Circularity tolerance: Limit the maximum change in diameter measured across any internal diameter to  $\pm 0.5$  percent.
      - b. Segment face lipping or offset shall be less than 3/8-inch or the tolerance established by the maximum allowable amount of gasket offset.
      - c. Limit ring roll to the following maximum absolute values:
      - d. Relative ring roll between adjacent rings: 1/8-inch.
        - 1) Do not allow propulsion shoes from EPBM to cross longitudinal joints.
  - F. Acceptance Criteria:
    - 1. Adequacy of Structural Design: Calculations demonstrating the ability of the segments to handle design loads in conjunction with:
      - a. Gasket line loads developed at the maximum allowable gaps.
      - b. Temporary construction loads, such as handling, transporting, and erecting and EPBM jacking, with and without full benefit of segment backfill grouting.
    - 2. The CONTRACTOR is responsible for the quality of precast concrete segments, and bears the burden of proof that all concrete as cast meets minimum requirements.
    - 3. Casting of segments to:
      - a. Individual panel and collective ring tolerances specified on approved CONTRACTOR's shop drawings.
      - b. Meet or exceed design requirements as specified, and verified and expanded by accepted CONTRACTOR-responsible design criteria.
      - c. Segments with cracks or honeycombing are not acceptable and will be rejected.
      - d. Segments not meeting the tolerances will be rejected.
      - e. Damage to gasket grooves in excess of 5 percent of the length will also be a cause for rejection.

## **PART 2 - PRODUCTS**

### **2.01 MATERIALS**

- A. Reinforcement:
  - 1. Steel fibers shall be in conformance with ASTM A820, Type I.

2. Steel reinforcement shall be in conformance with Section SS 03200 - Concrete Reinforcing.
- B. Concrete:
1. Conforming to COSA Item 300 - Concrete.
- C. Mechanical Joint Connector Systems:
1. Plastic dowels for circumferential joints:
    - a. Fiber reinforced engineered thermoplastic.
    - b. Ring formed pliable elastic surfaces.
    - c. Dowel size shall be selected by CONTRACTOR to meet design requirements
  2. Steel dowels for circumferential joints:
    - a. ASTM A108 Grade 1018.
- D. Gaskets:
1. Continuous over joint surfaces and of uniform gasket thickness along the entire length of mating surfaces.
  2. Elastomeric material free of imperfections including: voids, blisters, inclusions, flow marks, porosity, and pitting.
  3. Of such durability that residual contact pressure between the gasket surfaces is capable of resisting the maximum hydrostatic head and environmental conditions indicated in the GBR continuously, until the completion of the tunnel with the carrier pipe installed and annular backfill cured.
  4. Vulcanized Comers:
    - a. Made of dense elastomeric synthetic rubber.
    - b. Hardness: ASTM D2240. Durometer A; 65+/-5
    - c. Tensile Strength: ASTM D412, greater than 1,450 psi.
    - d. Elongation: ASTM D412, greater than 300 percent.
    - e. Compression Set: ASTM D395, Method B.
    - f. Short-Term: Less than 20 percent compression after 25 percent compression at 160 degrees F for 22 hours.
    - g. Long-Term: Less than 20 percent compression after 50 percent vertical compression after 70 hours at 212 degrees F.
    - h. Ozone Resistance: ASTM D1149, by method described in ASTM D518, Procedure A, with following stipulation: in a 200 parts per hundred million ozone solution for 100 hours at room temperature and 55 percent humidity.
    - i. Fire Rating: Self-extinguishing.
    - j. Water-tightness: Gaskets shall perform without exceeding the groundwater leakage criteria under the conditions specified herein.
- E. Packing:
1. Bituminous fiberboard compression joint packers or other material approved by the ENGINEER.
- F. Molds:
1. Utilize molds fabricated from steel in accordance with ACI 347.
  2. Fabricate molds with machined steel mating surfaces to conform to the dimensions and tolerances indicated. Provide segments with finished surfaces free from irregularities.

### **PART 3 - EXECUTION**

#### 3.01 GENERAL

- A. Coordinate tunnel excavation and installation of segmental lining as may be required by the CONTRACTOR's means and methods for performing tunnel excavation, support, and ancillary work.
- B. Use tapered rings as the exclusive means for negotiating curves and correcting horizontal and vertical misalignment.
- C. Do not use packing of variable thickness, or more than one packing in a segment joint.
- D. Regardless of the type of segment mechanical joint connector systems, do not remove interlocking elements subsequent to their installation unless immediately replaced.

#### 3.02 FABRICATION

- A. Workmanship:
  - 1. Furnish segments to be connected across joint faces. Provide joint connection assemblies to facilitate structural performance, achieve and maintain joint closure, required gasket compression, ring circularity, and assist in ring stabilization.
- B. Segment Preparation:
  - 1. Make concrete spacers from the same concrete mix design as the segments and compacted and cured to the same standards as the segments. Plastic spacers are not to be used.
- C. Segment Casting:
  - 1. Produce segments under controlled plant conditions with production areas protected against rain, dust and direct sunlight.
  - 2. Protect all concrete from hot and cold weather at all times during production.
  - 3. Keep a record of all the units cast in each form. Any form that becomes distorted or which casts faulty units shall be withdrawn from service until it is proved to the satisfaction of the ENGINEER to be corrected.
  - 4. Verify that the segments have attained the design strength prior to shipping through a combination of in-place strength testing and comparison with strength gain-maturity curves. Verify results with cylinder tests from concrete cured with segments.
- D. Consolidating:
  - 1. Work concrete into complete contact with forms and embedded items. Consolidate concrete adjacent to side forms and along the entire length of forms to ensure a smooth surface finish after stripping of formwork. Do not overconsolidate concrete causing segregation.
- E. Finishing:
  - 1. Check each form before and after production pour to ensure tolerances are maintained.
  - 2. Formed Surfaces:
    - a. Smooth form finish.
  - 3. If the extrados of the segments is not formed, it shall have a steel trowel finish and shall comply with the following:

- a. The maximum local irregularity shall be rounded protrusions of 1/8 inch in height above the general concrete surface.
  - b. The maximum surface irregularity over an area of 24 inches by 24 inches shall be 1/4 inch from maximum height to maximum depth.
  4. Compliance with the above finish limitations shall not eliminate the need to meet the tolerances specified in the Contract Documents.
- F. Steam curing for precast concrete segments:
1. Cure segments and protect during storage in accordance with ACI 533 and ACI 517.2R for steam curing:
    - a. After the segments are cast and attained preset time, place the segment forms in an enclosure or chamber large enough to allow complete circulation of steam.
    - b. Do not attempt to remove segments from forms until compressive strength of is attained, as required for handling and as determined by ASTM C39.
    - c. The ENGINEER reserves right to require increased compressive strength before removal of segments from forms if there is evidence of: distortion, cracking, spalling or similar damage that could have occurred during handling and storage of segments.
    - d. Enclosure or chamber ambient temperature shall be managed and maintained until the required stripping strength is attained.
    - e. Control cooling rate to limit temperature differential within segments to 35 degrees F to avoid thermal cracking.
    - f. Apply an approved curing compound on all surfaces immediately after removal of segments from steam curing.
  2. Protect concrete during the curing period from mechanical and physical stresses that may be caused by heavy equipment movement or handling of precast concrete segments subjecting the concrete to excessive loads.

### 3.03 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Ensure segments have attained the specified 28-day design strength before shipment.
- B. Transport the required amounts of segment panels in complete ring assemblies and as required to maintain a sufficient number of segment rings available to the tunneling operation.
- C. Protect gaskets and joint packing from direct exposure to sunlight and weather. Replace gaskets and joint packing that have shown signs of deterioration.
- D. Transport, store, and handle segments, avoiding damage to surfaces, edges and corners, and avoiding the development of stresses exceeding the capacity of the segment.
- E. Keep wire ropes, chains, and hooks from direct contact with segment surfaces, joint assemblies, gaskets, and joint packings.
- F. Use supports for storing segments.
- G. Discard defective and damaged segments.
- H. During cold weather, prevent water from filling the pockets and recesses of the segments and freezing.

### 3.04 SEGMENT PREPARATION

- A. Clean the segment erection area and prior erected segment surfaces to remove water, dirt, debris, and other foreign material prior to erecting each segment ring.
- B. Examine segments for structural damage and clean foreign material from all surfaces and gaskets prior to their erection.

### 3.05 INSTALLATION

- A. Liner shall, at all times, be erected within the tail shield of the EPBM without exposing the ground.
- B. Grip and erect segments in a manner to accurately position and align segments and gaskets within specified tolerances.
- C. Stagger joints so that longitudinal joints do not align with longitudinal joints in adjacent segment rings to form cruciform joints.
- D. Set segments to the required joint gap using the EPBM segment erector.
- E. Gasket along the longitudinal joint of the key segment may be lubricated prior to installation of key segment, if deemed necessary.
- F. Do not use positively interlocking elements to compress segment gaskets, but only to maintain segment gaskets in the compressed position.
- G. Completely erect and fasten segments within the EPBM tail shield before thrusting EPBM forward.
- H. Install the segment rings with the required circularity tolerance. At the request of the OWNER'S REPRESENTATIVE, make 4 sets of measurements of the inside segment ring diameter for each segment ring after installation, to verify that the required circularity limits are not exceeded.
- I. Where the tunnel exceeds specified tolerances, perform remedial work.
- J. Perform tail void grouting in accordance with Section SS 02411 - Tunneling with an Earth Pressure Balance Machine.

### 3.06 REPAIR OF DEFECTS

- A. Concrete segments with major damage which, in the opinion of the ENGINEER, impairs the structural integrity or performance will be rejected.
- B. Manufacturing Defects: The following procedures cover patching and repair of concrete segments with non-structural damage that will be used for correction of manufacturing defects in the concrete.
  - 1. Segments that show excessive crazing, damage or defects shall be recorded and investigated to determine the cause. Such segments shall, after completion of the investigation, be rejected or accepted following repair.

2. Cosmetic repairs of edge damage, scuff damage, and blow holes shall be performed where damage or a defect exceeds that listed in the following table.
3. Circumferential and radial edges shall be stone rubbed to remove sharp edges.
4. A defect or damage shall be deemed structural in nature if one or more of the following occur:
  - a. Connection hardware anchorage is exposed;
  - b. Cracking occurs in bearing areas;
  - c. Cracking extends from one face of the element through to the opposite face; and

5. Repair of damage shall be performed as shown in the following table:

<b>Manufacturing Defects Summary Table</b>				
<b>Class of Damage/Defect</b>	<b>Description</b>	<b>Location</b>	<b>Extent</b>	<b>Remedy</b>
Class A1 Non-Structural Patching	Blow holes and air voids	All locations except for gasket groove, intrados and caulking groove	Diameter > 0.6 in or depth > 0.2 in	Repair Procedure 2A
Class B Non-Structural Patching	Blow holes and air voids	Gasket groove	> 0.3 in diameter	Repair Procedure 1
Class C Non-Structural Cosmetic	Chipping and spalling	Gasket groove edges	Area: Length > 1 in x Depth > 0.2 in	Use Procedure 2A or 2B
Class D Non-Structural Cosmetic	Chipping and spalling	All locations except as noted in Class C	Area: > 1.5 in x 1.5 in or depth > 0.6 in	Use Procedure 2A or 2B
Class E1 Surface Irregularities	Local protrusions	Non-formed surfaces	> 0.12 in high	Stone rubbed or ground
Class E2 Surface Irregularities	Local protrusions	Formed surfaces	> 0.04 inch high	Stone rubbed, check mold
Class F1 Localized Surface Cracking and Crazing	Minor non-structural local defects	Gasket groove and extrados edge on joint faces	Cracks < 0.008 in wide	No repair
Class F2 Localized Surface Cracking and Crazing		Gasket groove and extrados edge on joint faces	Cracks > 0.008 in wide	Review for approval of repair procedure
Class F3 Localized Surface Cracking and Crazing		Extrados and all locations not noted in Class F1 or F2	Cracks < 0.01 in wide	No repair
Class G1 Structural Cracks		Radial joint bearing areas only	Any crack	Review for approval of repair procedure
Class G2 Structural Cracks		Circumferential joint bearing area only	Cracks < 0.002 in wide	No repair
Class G3 Structural Cracks			Cracks > 0.002 in and < 0.008 in wide that do not cross the gasket groove	Use Procedure 3
Class G5 Structural Cracks			Multiple cracks > 0.008 in wide emanating from a	Reject segment



<b>Manufacturing Defects Summary Table</b>				
<b>Class of Damage/Defect</b>	<b>Description</b>	<b>Location</b>	<b>Extent</b>	<b>Remedy</b>
			single source and producing a wedge pattern on the bearing face	
Class G6 Structural Cracks	See 3.6.B.4		See 3.6.B.4	Review for approval of repair procedure
Class H Broken Segment	Structural crack	Through segment	Full depth	Reject segment
Class J1 Honeycombing		At locations within the circle and radial joint bearing areas, and gasket grooves		Reject segment
Class J2 Honeycombing		All locations except as noted in Class J1		Use Procedure 2B
Class K Structural Damage	Damage exposing reinforcing	All surfaces except radial joints	To be assessed by examination	Review for approval of repair procedure

6. Repair procedures shall be as follows:

<b>Manufacturing Defects Repair Procedure 1</b>	
<b>Material:</b>	Type 30 Cement (High Early) Type 20 White Portland Cement Silica Sand Mix at the rate of one part cement to 2.5 parts sand, with 0.4 water/cement ratio. Proportion White Portland Cement as required for color matching.
<b>Procedure:</b>	1. Clean and wire brush off all dirt and dust from areas to be filled. Dampen repair area with water.
	2. Measure and mix cement and sand with water in accordance with the instructions. Do not re-temper mixture with water.
	3. Fill the repair area, and sack rub the finished surface.
<b>Manufacturing Defects Repair Procedures 2A and 2B</b>	
<b>Material 2A</b> to be used in areas less than 1.5 in long and 0.6 in deep.	
<b>Material:</b>	Sikadur 31 Epoxy Mortar by Sika Group or approved alternative. Mix in one-to-one ratio by volume adding oven-dried silica sand until a uniform and consistent mix is achieved. Do not mix a quantity larger than can be used within 30 minutes.
<b>Procedure:</b>	1. Repair area must be dry. Remove any dust, laitance, grease, oils or loose materials from the area to be repaired and wire brush.
	2. Place mixed material into the void working the material by trowel or spatula to ensure bond. Strike off level to existing concrete.
	3. Cure the epoxy mortar at a minimum temperature of 39 degrees Fahrenheit (°F).
	4. Ensure accurate profile by removing any excess mortar by grinding.

<b>Material 2B</b> to be used on area in excess of 1.5 in long and 0.6 in deep.	
<b>Material:</b>	EMACO S88-CA by BASF, or approved alternative. Mix at the rate of 50 lb bag EMACO with 0.7 to 1.0 gallons of water (10.5 percent - 15 percent by weight).
<b>Procedure:</b>	1. Saw-cut all edges of repair to a depth of 0.6 in with mechanical disc.
	2. Break back to sound concrete and remove surplus material by low impact method. Clean and wire brush off all loose particles, dirt and dust from areas to be filled. Soak burlap or sponge over the repair area to dampen for a period of 2 hours.
	3. Measure and mix the patching compound with water in accordance with the manufacturer's instructions. Do not re-temper mixture with water.
	4. Fill the repair area, and finish open edges with a steel trowel and use temporary formwork when necessary, ensuring that repair material is thoroughly compacted.
	5. Place a damp rag over the patch area and keep moist for a period of seven days until patch material is sufficiently cured.
<b>Manufacturing Defects Repair Procedure 3 – Crack Sealing</b>	
<b>Material:</b>	Sikadur Injection Gel by Sika Group or approved alternative. Mix in a ratio of 1:1 in accordance with the manufacturer's recommendation. Do not prepare more resin than can be used within 20 minutes.
<b>Procedure:</b>	1. Concrete must be clean and sound. Remove dust, laitance, grease, form oil, and foreign particles with a damp to dry cloth or sponge. Do not contaminate inside of crack.
	2a. Mix injection gel from coaxial cartridges by gunning equal beads on to a pallet and mixing thoroughly to a uniform color using a putty knife or spatula.
	2b. Using a putty knife or spatula, force material into the crack to seal it.
	3. Wipe excess resin from the surface, adjacent to the crack, using a dry cloth.
	4. Allow to cure for four hours before removing any remaining excess material with a rubbing stone.

7. Load testing may be specified by the ENGINEER, particularly for any repairs of concrete near the lifting area.

C. Handling and Installation Defects: Submit repair plan as required in this Section for review by ENGINEER.

D. In all cases, acceptance or rejection of a repaired segment shall be at the ENGINEER or OWNER'S REPRESENTATIVE's sole discretion.

### 3.07 INSTRUMENTATION AND MONITORING

A. In accordance with Section SS 01520 - Geotechnical Instrumentation and Monitoring.

B. Monitor the installation of each segment ring as related to the uniformity of the void space between the segment ring and the tail shield. Record the distance between the inside face of the tail shield and the segment ring extrados via two sets of four longitudinal measurements along the transverse horizontal and vertical centerlines of the segment ring at the leading edge:

C. Take the first set of measurements upon erecting the segment ring, but prior to thrusting against the ring.

- D. Take the last set of measurements upon completing the EPBM shove, but prior to installing the next segment ring.
- E. The ENGINEER may elect to eliminate some or all of these measurements if it becomes evident to the ENGINEER through visual or other means that the CONTRACTOR is consistently erecting the segment rings in accordance with specified requirements.
- F. Monitor the installation of each segment ring as related to the specified circularity tolerance in accordance with the requirements as specified herein.

**PART 4 - MEASUREMENT AND PAYMENT**

No separate measurement or payment will be made for work described under this item. All items associated with this Section will be incidental to items under Section SS 02410 – General Tunnel Requirements.

**END OF SECTION**

## **PART 1 - GENERAL**

### 1.01 SCOPE OF WORK

- A. Secant piles are specified to provide a water-tight support of excavation from the ground surface into competent bedrock for the W-6 Middle Connection Shaft, Solids Handling Shaft, and W-1 Connection Shaft. Refer to Section SS 02440 – General Shaft Requirements and the Contract Drawings for specified support of excavation all other shafts.

### 1.02 RELATED WORK

- A. Section SS 01510 – Pre and Post-Construction Inspections
- B. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- C. Section SS 02410 – General Tunneling Requirements
- D. Section SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM)
- E. Section SS 02412 – Tunneling with Non-Pressurized Shielded TBM
- F. Section SS 02413 – Hand Mining
- G. Section SS 02420 – Steel Liner Plate
- H. Section SS 02421 – Precast Concrete Segmental Liner
- I. Section SS 02422 – Shotcrete
- J. Section SS 02430 – Installation of Pipe in Tunnel
- K. Section SS 02431 – Annular Backfill for Carrier Pipe
- L. Section SS 02432 – Contact Grouting
- M. Section SS 02440 – General Shaft Requirements
- N. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. FHWA – NHI – 10-016 GEC 010 – Drilled Shafts Construction Procedures and LRFD Design Methods.

### 1.04 DEFINITIONS

- A. Secant Pile: a shaft formed by the installation of internally cast-in-place concrete drilled shafts which are in overlapping contact to each other at their perimeters.
- B. Primary Secant Pile: secant piles installed to form the overlap between secant piles and are typically unreinforced.

- C. Secondary Secant Pile: secant piles installed with reinforcement (if required) and alternating every other pile.

#### 1.05 GROUND CONDITIONS

- A. The work will be performed through subsurface conditions which have been investigated for the purpose of developing assumptions about ground conditions. Both a Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR) have been prepared based on this information.
- B. The primary objective of the GDR is to present the results of geotechnical investigations conducted for the project in a factual manner. These results include descriptions of field and laboratory investigations performed and procedures used, background physiography and regional geology information, and summaries of site subsurface conditions.
- C. The primary objectives of the GBR are to present the ENGINEER's interpretation of subsurface conditions and ground behavior, to present the basis of geotechnical design, to describe how these conditions might affect tunnel construction, and to present the geotechnical "baseline" for design that will be the basis for bidding, and resolution of potential differing site conditions with respect to the occurrence of different ground types and ground water anticipated for the work.

#### 1.06 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Conduct a Quality Control-Quality Assurance Program throughout the course of the work in accordance with the CONTRACTOR's reviewed Temporary Excavation Support Plan.
- B. Refer to ACI International (ACI) – 336.1 – Construction of Drilled Piers for general quality assurance and quality control requirements unless preceded by this document.
- C. The Secant Pile Contractor shall demonstrate experience that includes installation of secant piles through varying subsurface materials and maintaining verticality. The CONTRACTOR experience shall be with similar equipment and methods for which the CONTRACTOR proposes for this work.
- D. The Secant Pile CONTRACTOR's superintendent and lead drillers shall be skilled in the installation of secant piles of similar diameter, depth, and rock penetration in comparable conditions for the purpose of excavating, cleaning holes, placing steel core and placing concrete for secant piles.
- E. Document inspection of excavation and placement of concrete as specified herein.
- F. Conform to Quality Control program prepared by the CONTRACTOR and submitted and reviewed by the ENGINEER.
- G. Field Quality Control shall be as follows:
  - 1. The CONTRACTOR shall be fully responsible for installing and maintaining the secant piles necessary to minimize movements of the earth support wall during all stages of construction.
  - 2. The CONTRACTOR shall be responsible for making prompt evaluations of the test data and, whenever necessary, taking immediate steps to correct any deficiencies in the

capacities of individual members or other parts of the system which may be required to prevent damage or excessive wall movement.

3. Measure and record the slump of concrete at the beginning of the concrete placement.
4. For a wheelbarrow sample of the first load of concrete actually deposited into each secant pile, measure and record the slump of the concrete at the end of concrete placement, noting the time of the final slump measurement and the slump loss for the initial concrete load during concrete placement. Cover and protect samples waiting for final slump measurement from excessive heat, cold, moisture, or wind during concrete placement.
5. Testing of concrete cylinders shall be as specified in COSA Item 300 – Concrete.
6. Welding:
  - a. Welding shall be done by welders qualified in accordance with the requirements of AWS D1.1.
  - b. Inspection and non-destructive testing of welded points shall be performed as specified.

#### 1.07 SUBMITTALS

A. Submittals shall be in accordance with Section SS 01300 – Submittals.

B. Submittals for Secant Piles shall be sealed by a registered Professional Engineer(s) licensed in the State of Texas and shall be subject to review by ENGINEER. At least twelve weeks prior to mobilization of grouting operations, submit for review by ENGINEER, in addition to the submittal requirements specified in Section SS 02440 – General Shaft Requirements, submit the following for each individual shaft required to be supported using secant piles:

1. Secant Pile Work Plan:
  - a. Name and experience record of the drilling superintendent in charge of drilling operations.
  - b. List of proposed materials and equipment to be used including but not limited to cranes, drills, augers, casing, bailing buckets, water pumps, airlift equipment, final cleaning equipment, final inspection equipment, tremies, and concrete pumps.
  - c. Details of overall construction operation sequence and the sequence of secant pile construction including but not limited to shaft dimensions, secant pile dimensions, reinforcement, overlap, ring beams, and shaft floor.
  - d. Details of protection for structures near the secant pile work.
  - e. Details of procedures, equipment, scheduling and other measures to minimize and mitigate both noise and vibrations from excavation, drilling, and concrete placement operations.
  - f. Details of procedures, equipment, scheduling and other measures to minimize and mitigate spread and perform daily cleanup of excavated soil and rock spoils, water, or concrete from excavation, drilling, and concrete placement operations.
  - g. Details of secant pile drilling methods.
  - h. Details of methods to survey secant pile excavations for vertical alignment and methods to correct if pile is not within specified tolerances.
  - i. Details of methods to clean the secant pile excavations prior to concrete placement.
  - j. Details of steel reinforcement (if necessary), and its placement, including support and centralization methods.
  - k. Concrete mix design.
  - l. Details of concrete placement including proposed operational procedures for tremie and concrete pumping methods.
  - m. Description of procedures for withdrawal of steel casing to prevent concrete from being lifted or contaminated during withdrawal.

- n. Methods of removal or drilling through cobbles, boulders, concrete and other obstructions.
  - o. Quality Control program for secant pile installation including equipment for measuring the verticality of the installed secant piles prior to concrete placement.
- C. Shop Drawings:
- 1. Notes for construction of secant pile support of excavation.
  - 2. Sequence of secant pile installations.
  - 3. Details of construction and installation of fabricated items including materials, dimensions, methods of joining, fastening and anchoring.
- D. Welding procedures and qualifications of welders and tackers as specified in AWS D1.1.
- E. Certified mill test reports for deformed bar reinforcing.

#### 1.08 GENERAL REQUIREMENTS

- A. Secant piles shall overlap such that the seal between the primary and secondary piles is watertight to less than 0.5 GPM per shaft. Remedial measures including grouting between shafts with polymer, fine neat cement grout, or tertiary shafts shall be installed to meet this requirement at no additional cost to the OWNER.
- B. Minimum embedment into a competent, watertight formation shall be achieved as determined by the CONTRACTOR and as indicated on the Contract Drawings Sheet TU-20.
- C. Overlap, diameter, layout, and reinforcing shall be determined by the CONTRACTOR while still meeting the specified tolerances herein.
- D. If, during excavation, instrumentation readings indicate that limiting values are approached or exceeded as defined in Section SS 01520 – Geotechnical Instrumentation and Monitoring, take remedial steps to arrest movements and restore all affected structures.
- E. Perform preparatory work to discover, protect, maintain, relocate and restore utility service facilities.
- F. Employ construction methods that prevent the spillage of excavated materials, slurry, and concrete into utilities, streets, sidewalks, and other facilities.
- G. Install guide walls as required and remove and dispose of guide walls after completion of the secant pile walls.
- H. Clean the bottom of excavated piles thoroughly prior to placement of reinforcing and concrete.
- I. Tolerances shall be as follows:
  - 1. The drilled secant pile excavation center line shall be within 1-inch of plan position in the horizontal plane at the plan elevation for the top of the pile excavation.
  - 2. The vertical alignment of each secant pile excavation shall not vary from the plan alignment by more than 0.4 percent of the pile length.
  - 3. The top of installed secant pile walls shall not be lower than the elevation specified in the reviewed submittal drawings.

- J. Construction of secant pile walls includes, but is not limited to, the following items, as reviewed by ENGINEER on submittals provided by the CONTRACTOR:
1. Mobilization and demobilization to each shaft location.
  2. Pre-excavation of existing obstructions along line of secant pile support of excavation and backfilling with appropriate materials. Excavation of starter trenches and installation of guide walls as required.
  3. Excavation of secant piles.
  4. Stabilization of excavated secant pile until placement of concrete and reinforcing steel as required.
  5. Placing all keyways and dowels as required for framing and additional sleeves and anchorage assemblies as required for tiebacks or temporary or permanent construction.
  6. Placement of concrete and/or reinforcing steel (as required) in each secant pile.
  7. Cleaning and patching of all areas of voids, honeycombs, aggregate runs, and pockets.
  8. Grouting and sealing, as required, to render the wall watertight.
  9. Clean up and removal of excavated soil and any other spoils or slurry used during construction.

## **PART 2 - PRODUCTS**

- A. Concrete mix materials shall be in accordance with COSA Item 300 - Concrete with a minimum 3000 psi compressive strength.
- B. Temporary Casings: Casings shall be steel, smooth, completely clean inside and outside, watertight, with uniform circular cross section, completely straight, with no bends, with square ends free of deformation, and of ample strength to withstand both handling and driving stresses and the pressure of both concrete and the surrounding earth materials, groundwater, building loads, and ground loads. The outside diameter of casing shall not be less than the required size of secant pile excavation. All casings shall be removed from secant pile excavations while concrete placed within is still plastic. Casings shall conform to the requirements of ASTM A-252, Grade 2, having a wall thickness no less than 1-inch. Determination of the extent of additional wall thickness necessary to facilitate construction shall be the sole responsibility of the CONTRACTOR.

## **PART 3 - EQUIPMENT**

- A. The excavation and drilling equipment shall have adequate capacity including power, torque, and down thrust to excavate a hole of both the maximum diameter and to a depth of 20 percent beyond the maximum depth of excavation indicated in the CONTRACTORS Secant Pile Wall Plan and capable of installing piles in accordance with the ground conditions described in the GBR. The excavation tools, drilling tools, and all necessary ancillary tools and equipment shall be of adequate design, size, and strength to perform the work as specified in both soil (including the presence of cobbles) and rock.
- B. The excavation and drilling equipment shall be maintained in good operating condition to the satisfaction of the OWNER. Mufflers and noise mitigation accessories shall be maintained and in good working condition throughout the work.
- C. When the material encountered cannot be drilled using conventional earth augers or under-reaming tool, provide special drilling equipment including rock core barrels, rock tools, air tools, and other equipment as necessary to construct the secant pile excavation to the size and



depth required. Airlifts of any type within the casing and drilling tools that cause circulation outside the casing or drop in fluid level within the casing are not permitted.

#### **PART 4 - EXECUTION**

##### **A. Preparation:**

1. Use placement method that does not cause settlement, displacement or damage to nearby structures.
2. Protect structures near the work from damage as specified in Section SS 01520 – Geotechnical Instrumentation and Monitoring and on the Contract Drawings.
3. Maintain positive groundwater level inside temporary casing at all times.
4. All groundwater control equipment and temporary casing shall be on-site prior to commencement of drilling operations.
5. The CONTRACTOR shall have equipment for checking the dimensions and alignment of each secant pile hole excavation. Final hole depths shall be measured with a suitable weighted tape or other accepted methods after final cleaning. Hole clean lines will be determined by sounding the bottom of the hole.
6. The CONTRACTOR shall have equipment for measuring verticality of the hole. The measuring device shall be able to accurately measure within 1/4-inch and up to a depth of 150-feet.
7. All secant pile holes shall be inspected by ENGINEER or OWNER's REPRESENTATIVE prior to placement of steel reinforcement and concrete.

##### **B. Operations:**

1. Vibration or excessive wheel loads shall not be permitted within the immediate vicinity of any pile. Shaft excavation stability shall be maintained at all times.
2. Drill secant pile excavations to diameters and depths as shown in the CONTRACTOR's submittal.
3. Reinforcement shall be placed in alternating piles, as shown on the reviewed submittal drawings.

##### **C. Sequencing and Scheduling:**

1. The pile installation sequence shall be determined by the CONTRACTOR, subject to the review by the ENGINEER and OWNER's REPRESENTATIVE.
2. Excavating, installation of reinforcing steel and concreting shall be scheduled so that each secant pile is constructed in a continuous operation with no scheduled pauses or delays.
3. Immediately after completion of drilling to required penetration, clean the secant pile excavation bottom of loose material as specified herein.
4. Inspect secant pile excavations for cleanliness immediately before placement of reinforcement and concrete.
5. Place reinforcing steel immediately after successful secant pile excavation inspection.
6. Immediately after installation of deformed bar reinforcing, place concrete as specified herein below. Do not leave completed secant pile excavations unconcreted longer than four hours after required penetration depth drilling is reached.

##### **D. Excavation:**

1. The excavation operations shall be controlled to ensure stable conditions at all times during installation of secant piles.
2. It is expected that groundwater may be encountered during secant pile excavation operations. Maintain positive groundwater level inside temporary casing at all times.

3. Install temporary casing to maintain the hole until concrete is placed as required. Temporary casing shall be removed while the concrete remains workable. In soil, maintain the secant pile excavation above the bottom of the casing. Maintain the casing at least five feet below the top of the concrete during withdrawal of the casing.
  4. Surface and subsurface obstructions at secant pile locations shall be removed by the CONTRACTOR.
- E. Placement of Reinforcement:
1. Tie and support reinforcement in the secant pile excavation so that the reinforcing steel remains within allowable tolerances specified. Use concrete spacers or other acceptable non-corrosive spacing devices at sufficient intervals (near the bottom and at intervals not exceeding 10-feet up the hole) to ensure concentric spacing for the entire reinforcement length. Construct spacers of acceptable material equal in quality and durability to the concrete specified for the secant pile excavation.
  2. Reinforcing steel cage (if used) damaged during transportation, handling or installation which cannot be rebuilt, extended, or encased, shall be removed. Another reinforcing cage shall then be placed at the required location at no additional expense to the OWNER.
  3. Reinforcement placed and accepted, shall be cut off perpendicular to the vertical axis, at the elevation shown on the reviewed submittal drawings. Cut off sections of deformed bar reinforcement shall be removed from the site and suitably disposed of by the CONTRACTOR.
  4. Check the elevation of the top of the reinforcement before and after concrete is placed. If the reinforcement is not maintained within the specified tolerances, make corrections to meet tolerances before concrete is set.
  5. Ensure that reinforcement does not conflict with excavation for the tunnel.
- F. Placement of Concrete:
1. The reinforcement and concrete shall be placed immediately after the bored hole has been inspected.
  2. Concrete shall be placed in accordance with the following requirements:
    - a. Concrete shall be placed at the bottom of the hole using tremie methods.
    - b. Place all concrete continuously from the bottom to the top elevation of the secant pile excavation in a manner to prevent damage and displacement of reinforcing steel.
  3. Adjust admixtures in the concrete mix for the conditions encountered in the Work so that concrete remains in a workable plastic state maintaining the minimum required concrete slump throughout placement.
  4. Remove the temporary casing as specified. During extraction of the casing, prevent upward movement of the steel reinforcement, if used.
- G. Remediation of Secant Piles, Seams and Interfaces:
1. Throughout general excavation inside the completed secant pile wall enclosures, vertical seams between each adjacent pair of secant piles, as well as any vertical interfaces between the ends of secant pile wall lines and adjacent non-secant pile temporary support walls or structures of differing design, shall be inspected for signs of incomplete bonding, separations, groundwater leakage, soil inclusions, and other defects.
  2. The CONTRACTOR and OWNER's REPRESENTATIVE shall inspect the vertical secant pile seams and vertical secant pile interfaces. For any seams or interfaces that the CONTRACTOR or OWNER's REPRESENTATIVE determines to be insufficiently stable and/or insufficiently watertight, the CONTRACTOR shall provide suitable remediation to meet tolerances specified.

3. Remediation of the vertical secant pile seams and vertical secant pile wall interfaces may consist of, but shall not be limited to, chipping and replacement of defective concrete, addition of structural reinforcement, grouting, and/or construction of replacement secant piles.

H. Records:

1. A record shall be provided to ENGINEER and OWNER's REPRESENTATIVE, on accepted forms, for each secant pile installed, and for each shaft constructed using secant piles. A complete record compilation of each secant pile installed as part of an individual shaft shall be provided to the ENGINEER and OWNER's REPRESENTATIVE within two days of installation of the last secant pile associated with that individual shaft. For each secant pile, provide a separate Secant Pile Log with complete details containing:
  - a. Secant pile number, location, final top and bottom elevations of reinforcement and final top and bottom elevations of cast-in-place concrete.
  - b. Final location of secant pile axis and steel core axis at ground level, and variation from design location.
  - c. Secant pile and steel core plumbness and direction of any drift from planned position shown on accepted Shop Drawings.
  - d. Secant pile diameter and any variations in diameter with depth.
  - e. Date and time of start and completion of pile shaft excavation.
  - f. Date and time of start and completion of installation of reinforcement.
  - g. Date and time of start and completion of placement of concrete, including removal of casing.
  - h. Elevation of water table during excavation.
  - i. Size and arrangement of reinforcement, and location of splices.
  - j. Concrete data including design mix, volume placed, and method of placement.
  - k. Other documentation as may be dictated by construction conditions including problems encountered, and delays.
  - l. Secant piles that fail, are placed out of position, fail to bond adequately to adjacent secant piles or structures, contain excessive concrete contamination, damaged, or are defective in any respect shall be considered unacceptable secant piles, and shall be replaced or repaired at no additional cost to the OWNER.

**PART 5 - MEASUREMENT AND PAYMENT**

No separate measurement or payment will be made for work described under this item. All items associated with this section will be incidental to items under Section SS 02440 – General Shaft Requirements.

**END OF SECTION**

**PART 1 GENERAL**

1.01 SCOPE

- A. This section covers a prepackaged, Parshall flume-type, fiberglass metering manhole for the following metering station:

<b>Packaged Metering Manhole</b>	<b>Parshall Flume Size</b>	<b>Current (2019) Average Daily Flow</b>	<b>2040 Peak Wet Weather Flow</b>
PMM 1.0	12-inch	1.41 MGD	3.73 MGD

1.02 GENERAL

- A. Equipment furnished and installed under this section shall be fabricated and installed in full conformity with detailed drawings, specifications, and data of the equipment manufacturer, unless exceptions are noted by the Engineer. The work to be performed under this section shall consist of furnishing all materials, labor, tools, equipment, and incidentals as specified herein and as shown on the drawings.

1.03 REFERENCES

- A. Design, fabricate PMMs, and materials in accordance with manufacturer’s recommended procedures and the following codes and standards:
1. ASTM A193 - Stainless Steel Anchor Bolts
  2. ASTM D 256 - Izod Impact Strength
  3. ASTM D 570 - Water Absorption Rate
  4. ASTM D 638 - Tensile Strength
  5. ASTM D695 - Compressive Properties of Rigid Plastic
  6. ASTM D 696 - Coefficient of Linear Expansion
  7. ASTM D 790 - Flexural Properties
  8. ASTM D792 - Density and Specific Gravity at 230 C
  9. ASTM D2563-0 - Visual Defects
  10. ASTM D 2583 - Indentation Hardness
  11. ASTM D2584 - Resin, Glass & Filler Content
  12. ASTM D3753-12 - Polyester Manholes
  13. ISO1438/1-1980 - Open Channel Flow Measurement
  14. OSHA 1910.27 - Fixed Ladders
- B. Composition of the PMM laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermoset Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship of the Society of the Plastics Industry, Inc. (SPI), and the Material Technology Institute (MTI) of the Chemical Process Industry for “Hand Lay-UP Laminates,” and shall meet the specifications for Type I, Grade 10 laminates shown in Appendix M-1 of said report.
- C. Manufacturer must provide warranty for 25 years against failure due to corrosion.

1.04 SUBMITTALS

- A. Complete installation drawings and product data, together with all critical dimensions shown, detailed specifications, and data covering all equipment furnished, shall be submitted in accordance with the submittals section.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Ship all PMMs with suitable packaging to protect products from damage.
- B. Protect PMM flanges, tabs and accessories from damage.
- C. The PMM shall be stored on a smooth flat surface, free of sharp objects, and if laid horizontally, shall be placed in such a way as to avoid structural damage.

1.06 O&M MANUAL

- A. An operations and maintenance manual shall be furnished. The manual shall include record drawings to reflect actual installation and three (3) copies of operating instructions for each item furnished. This information shall cover operations, maintenance, repairs, dismantling or assembling and parts list, if any. This data shall be grouped and assembled under a suitable common cover, as approved by the Engineer.

1.07 WARRANTY

- A. The metering station shall include a minimum of one (1) year warranty on all components and parts from the date of acceptance of the PMM by the San Antonio Water System. A copy of the warranty shall be included in the O&M manual.

**PART 2 PRODUCTS**

2.01 ACCEPTABLE MANUFACTURERS

- A. Acceptable manufacturers include Belco Manufacturing Company, Plasti-Fab, Inc., or Associated Fiberglass Enterprises. No other manufactures will be accepted.

2.02 MATERIALS

- A. PMM body shall be:
  - 1. Engineered composite fiberglass reinforced plastic (FRP).
    - a. Molded in one piece to create a seamless corrosion barrier impervious to moisture.
    - b. FRP resin shall be polyester.
  - 2. All hardware (when applicable): T-304L stainless steel.
- B. Concrete
  - 1. Concrete, formwork, waterstops, and reinforcing steel shall be as specified in COSA Item 300 - Concrete.

2.03 DESIGN CRITERIA

- A. PMM shall conform to ASTM D3753-12
- B. Composition of the PMM laminate shall be in accordance with the recommendations shown in the Quality Assurance Report for Reinforced Thermostat Plastic (RTP) Corrosion Resistant Equipment prepared under the sponsorship the Society of the Plastics Industry, Inc. (SPI) and the Material Technology Institute of the Chemical Process Industries, Inc. (MTI) for “Hand Lay-up Laminates” and shall meet the specifications for Type 1, Grade 10 laminates shown in Appendix M-1 of said report.
1. Visual inspection for defects shall be made without the aid of magnification and defects shall be classified as to type and level as shown in Table 1 of ANSI/ASTM D2563-0, approved 1977, (or any subsequent revision). Allowable surface tolerances are as follows:

<b>DEFECTS</b>	<b>ALLOWABLE TOLERANCE</b>
Cracks Crazing Blisters Chips Pits Dry Spots Fish Eyes Burned Areas Entrapped Air	None
Wrinkles and solid blisters, not to exceed 1/8”	Maximum Deviation: 10% of thickness
Surface porosity (pinholes or pores in the laminate surface)	None
Exposed Glass Exposure of cut edges	None
Scratches	None more than .002” deep (.05mm)
Foreign Matter	None

2.04 CONSTRUCTION

A. PACKAGED METERING MANHOLE

- Each Packaged Metering Manhole shall be a complete integral unit consisting of: a corrosion resistant fiberglass reinforced plastic (FRP) manhole with sealed fiberglass bottom, metering flume, and accessories as required.
- PMM body shall be totally manufactured of fiberglass reinforced polyester.
- Each PMM shall be molded individually to the exact dimensions specified.
- The thickness of the walls and floor of the PMM shall be not less than 1/2" thick.

5. PMMs shall be manufactured of reinforced thermoset plastic in one integral piece that is structurally strong, lightweight, watertight and corrosion resistant to salt water, ground water, corrosive soil conditions and many commonly encountered industrial chemicals.
6. PMM inside surface shall be smooth, isophthalic gelcoat of 10 - 20 mil thickness. Exterior Surface shall be grey gel coat 15-20 mil thickness for UV protection.
7. The surface shall be free of exposed reinforcing fibers.
8. The minimum glass content shall be 30% exclusive of gelcoat surfaces.
9. Any portion of the flume or end adapters extending outside the manhole shall have a reinforced cover.
10. The manhole sides, bottom and external flume sections shall be designed to withstand a static load of 150 lb/ft per foot of depth with less than 1/4" deflection.
11. There shall be no light duty angles of flanges protruding beyond the flume or manhole that can be damaged by shear or load forces.
12. Inlet and Outlet Pipes: The FRP manhole and flume shall be provided with 24-inch O.D. pipe stubs for connection to 24-inch O.D. incoming and outgoing PVC pipe. Flume end adapters shall allow a smooth flow transition from pipe flow to flume flow.
  - a. Two neoprene boots with stainless steel clamping bands shall be supplied and sized to connect inlet and outlet pipe stubs to the pipeline.

#### B. COVER

1. The Packaged Metering Manhole shall have a concentric manway designed to withstand a 16,000 lb. vertical dynamic wheel load (H-20), plus lateral forces from earth loading, ground water and frozen soil. The manhole opening shall be a 5' diameter barrel use 22-1/2" I.D. manway for use with a cast iron cover, suitable for H-20 highway loading.

#### C. UTILITY TAP

1. The manhole barrel shall be fitted with 2" FRP through-wall utility tap(s) having threaded connections to permit sub-grade entrance for power, sample or recording lines without damaging the watertight integrity of the manhole.
2. The manhole shall be equipped with hold down brackets for anchoring the unit to a concrete slab.

#### D. TRANSDUCER BRACKET

1. Brackets shall be provided for installation of a transducer for ultrasonic flow

measurement, as shown on the drawings. The mounting brackets and hardware shall be fabricated from 316 stainless steel.

#### E. MANHOLE DIMENSIONS

1. Fiberglass manhole barrel shall be 60" diameter.
2. Manhole shall be 10.11 feet (invert to grade).

#### F. PARSHALL FLUME

1. The Parshall flume shall have the dimensions prescribed by the U.S. Department of Interior, Bureau of Reclamation, Water Measurement Manual, latest revision, and the throat width indicated on the drawings. The flume shall be accurate in dimension. The approach, the throat and downstream sections shall be formed in one continuous mold. The flume shall be bonded into the manhole to form a totally integral flow measurement manhole package. The resultant structure shall be watertight. The inside surface of the flume shall be smooth and free of any irregularities. The approach section shall be designed to omit turbulence. A directional arrow shall be placed on the floor of the flume approach section to indicate direction of flow.
2. Nominal wall thickness shall be a minimum of 1/4" for areas inside the barrel and 1/2" minimum for portions extending beyond the barrel.
3. Flume extending beyond the manhole shall have a reinforced watertight fiberglass cover of sufficient strength to withstand soil loads when backfilled.
4. A grating shall be provided to cover the flume. The grate shall have an 18-inch opening located below the transducer and shall be hinged. The cover shall be adequate to support a 300-lb load.
5. The flume shall be maintenance free and dimensionally stable.
6. The opening in the bottom of the metering manhole shall be located over the optimum measuring point of the flume (2/3A), as shown on the drawings.

### **PART 3 EXECUTION**

#### 3.01 NOTIFICATION

- A A pre-construction conference and notification 72 hours prior to construction of the meter station is mandatory. San Antonio Water System reserves the right to inspect the metering facilities at any time and to impose conditions of construction necessary to protect SAWS facilities or the ability to operate and maintain those facilities.

#### 3.02 INSTALLATION

- A. Installation of the prefabricated metering manhole shall conform to the manufacturer's recommendation and shall comply with the following:
  1. A level, reinforced concrete pad, as shown on the construction plans, shall be initially constructed for the base of the fiberglass manhole and flume. The dimensions and



levelness of this pad must be verified in the field by a SAWS representative prior to the installation of the fiberglass manhole. The pad shall be a minimum of seven feet in width and shall extend a minimum of one foot beyond the ends of the flume adapters. The pad thickness shall be as shown on the plans. T-304 stainless steel anchor bolts shall be set at the locations indicated on the plans.

2. Subgrade preparation for the concrete leveling pad shall be as specified on the drawings.
3. PMM's too large to ship in one piece will be shipped in flanged and match-drilled sections along with stainless steel fasteners for onsite assembly.
4. Verify that dimensions are correct and project conditions are suitable for installation. Do not proceed with installation until unsatisfactory conditions have been corrected.
5. Thoroughly clean and remove all shipping materials prior to setting.
6. Install products in accordance with engineer's specifications, local codes, general comments below and the Manufacturer's recommendations.
7. Care shall be taken in the handling, storage and placement of the PMM in preparation for installation. The contractor shall become familiar with the recommended handling and installation procedures used with fiberglass Metering Manholes to ensure that the manhole is not damaged, and that the flume is installed in a manner that is consistent with obtaining good Open Channel flow results.
8. Slinging will be accomplished using nylon or other fabric material. Under no circumstances shall cable or chain slings be used in direct contact with fiberglass surfaces.
9. The PMM shall be installed level end-to-end and side-to-side and must remain level throughout installation. The flume is factory installed in the Metering Manhole so that it is absolutely level from front to back and from side to side and must remain level after installation.
10. The site shall be excavated wide enough to accommodate the manhole and to provide a safe working environment for workers.
11. The contractor shall provide a level concrete slab with a smooth troweled surface. Pad elevation shall be as shown on the drawings and positioned so that the invert of manhole piping matches that of the pipeline. Prior to manhole placement the slab shall be cleaned of all sharp objects and debris.
12. The foam pad supplied with the manhole shall be placed in the proper position.
13. If the pipe is already in place the neoprene boots and s/s bands shall be slipped onto the pipe ends before lowering manhole onto concrete slab. The neoprene boots can be slipped over pipe ends and the stainless-steel clamps tightened securely. Under no circumstances

shall petroleum lubricants of any type be used to install neoprene boots.

14. Packaged Metering Manhole shall be lowered onto pad in accordance with the manufacturer's written recommendations.
15. Flume level shall be checked and PMM adjusted if necessary.
16. After the level is confirmed all anchor bolts shall be securely tightened.
17. The fiberglass manhole and flume shall be grouted in place as shown on the plans. All voids between the fiberglass manhole and felt pad (which is placed on top of the concrete pad) shall be grouted in. All voids between the inside diameter of the fiberglass manhole and the flume shall be filled with dry cushion sand to within 4 inches of the top of the flume and then capped with 4 inches of concrete or high-density foam capped with fiberglass and a non-skid surface. Whichever method is used, the resultant surface shall be sloped at ½ inch per foot towards the flume opening for proper drainage. The resultant structure shall be watertight. The flume shall be leveled, adjusting as necessary, and checked prior to backfilling.

### 3.03 START-UP

- A. Check Flume for being level both directions and PMM for meeting dimensional requirements and cleaned per manufacturer's instructions.
- B. Start-up / calibration of meter per Section SS17300 ULTRASONIC LEVEL FLOW METER.
- C. Representative shall complete a Certification of Proper Installation and provide copies to the Owner, Engineer, Contractor and Manufacturing Facility.
- D. Construction debris shall be removed from the metering station and flume by the Contractor before the metering station will be accepted.

## **PART 4 MEASUREMENT AND PAYMENT**

Measurement and payment shall be made on a lump sum basis. Items included in this payment item shall include the packaged metering manhole, control panel, conduit, conductors, ultrasonic level transducer, remote terminal display, and h-frame equipment rack as well as materials, equipment, labor, and all other items required to install the packaged metering manhole.

**END OF SECTION**

## **PART 1 – GENERAL**

### **1.01 SCOPE OF WORK**

- A. In accordance with General Condition 5.13, Contractor shall prepare a Baseline Schedule for the project. The Baseline Schedule shall include all required items listed in the General Conditions as well as incorporate the sequencing milestone items included in Section 1.03 of this specification. The project milestones shall be included in the Baseline Schedule along with any other key milestones determined by the CONTRACTOR.
- B. Tie-Ins will be required at several key locations along the project alignment and will be made to existing infrastructure with large amounts of existing flow. The W-1 tie-in is of special consideration as it will have a temporary connection in place that requires regular cleaning in order to maintain adequate flow.

### **1.02 CONSTRUCTION SEQUENCE**

The CONTRACTOR shall perform work while the system remains in service during the construction period. CONTRACTOR shall review the sewer tie-ins identified in the Plans and develop a comprehensive detailed sequence plan that includes sequencing of bypass pumping and submit to OWNER and ENGINEER for review prior to beginning construction. Some construction activities may require temporary bypass pumping, bulkheads, temporary plugs, and use of stop planks. Bypass pumping requirements are specified in Section SP864. CONTRACTOR is responsible for providing temporary bulkheads, stop planks, plugs, pumps and other equipment, as required, at no additional cost to the OWNER. CONTRACTOR shall plan for the use of temporary plugs and pumping for installation of and leakage from the temporary bulkheads, and stop planks. Completion dates of the various sequenced stages shall be in accordance with the accepted Baseline Schedule submitted by the CONTRACTOR.

Following OWNER and ENGINEER approval of the detailed sequence plan, the CONTRACTOR shall give the OWNER a minimum of 48-hour notice before beginning each phase of construction. Perform the work as required to complete the entire project within the contract time and in the general sequence stipulated below. If the CONTRACTOR elects to deviate from the approved sequencing plan, the CONTRACTOR shall submit the revised plan to the OWNER and ENGINEER for approval a minimum of 21-days in advance of performing work within the revised sequence.

- A. CONTRACTOR shall install temporary erosion control measures per the Drawings and requirements of these Specifications.
- B. CONTRACTOR shall install bypass pumping as required in accordance with Item No. 864 Bypass Pumping of the SAWS Standard Specifications for Construction.

### **1.03 SEQUENCE MILESTONES**

Contractor shall schedule the construction of the project in a manner that best suits the Contractor's means and methods while adhering to the contract time and general construction sequence. Contractor shall include the following key milestones in the comprehensive detailed sequence plan and construction schedule.

	<b>Milestone</b>	<b>Notes</b>	<b>Reference</b>
<b>Permitting and Coordination</b>	TxDOT UIR	Requires a 60-day duration for submission and approval	Special Conditions
	CoSA ROW	Requires a 60-day duration for approval	City of San Antonio
	JBSA	Requires security clearance and coordination associated with construction.  Dig Permit must be submitted a minimum of 30 days in advance of required approval for work to commence.	Special Conditions
	CPS Energy	Electric Power Supply requires coordination with SAWS and CPS Energy to submit the TBM and site power requirements for CPS Energy to begin construction of power to sites. Nine (9) month time frame for installation.	Special Conditions
	Nelson Wolff Stadium	Requires coordination with Facilities Director 30-days following NTP. Include scheduled events in project schedule.	Special Conditions
	Federal Aviation Administration	Requires notification to Kelly Field Manager 3-days (business days) prior to erection of any temporary vertical structures at Shafts #1 and #8.	Special Conditions

	Property in Easement	Private Property stored within easement requires coordination with property owner prior to removal.	Special Conditions
<b>Construction Sequencing</b>	Bypass Pumping	Requires sequence for each location	Sheet G38-G43
	W-6/W-1 Connection	Based on W-1 construction, include connection schedule and tie-ins	Sheet C75
	Lateral Connections	Connections not anticipated to occur until all flows transferred	Sheet C76-C83
	Sliplining	Sliplining not anticipated to occur until all flows transferred to 104-inch sewer	Sheet C83A

**PART 2 – EXECUTION**

2.01 EXECUTION OF TIE-INS AND MAINTENANCE

The W-1 to W-6 connection will require routine cleaning and maintenance to maintain proper flow into the existing 54-inch sanitary sewer main.

- A. Contractor shall be required to clean and maintain the W-1 Connection to the existing 54-inch sanitary sewer main until all flows are permanently transferred into the W-6 sanitary sewer main.
- B. Contractor shall clear the W-1 Connection of debris utilizing a vacuum truck to allow the maximum flow within the W-1 piping. The W-1 Connection shall be inspected for debris accumulation on a weekly basis and cleaned as required by the Owner but no less than one (1) time per month.
- C. Contractor shall be required to clean a minimum of 1,000 feet upstream of the W-1 Connection via a sanitary sewer jetting machine once the flows are permanently transferred to W-6 to clear the W-1 sanitary sewer main of any accumulated or settled debris.

**PART 3 – MEASUREMENT AND PAYMENT**

3.01 MEASUREMENT AND PAYMENT

- A. No separate measurement or payment will be made for work described under Part 1 of this Section.
- B. All work required under Part 2 of this Section will be measured as a Lump Sum item.
- C. All work required under Part 2 of this Section will be paid at the contract unit bid price included in the price proposal. The lump sum price shall include full compensation for all work herein specified including all labor, equipment and materials to perform the cleaning and maintenance activities specified in this Section.

**END OF SECTION**

## **PART 1 - GENERAL**

### 1.01 SCOPE OF WORK

- A. This Section specifies requirements for annular backfill between the initial tunnel support and carrier pipe including: developing and preparing mix designs, testing and verifying mixes, batching, transporting, and placing annular backfill between the initial support and the carrier pipe.

### 1.02 RELATED WORK

- A. Section SS 01510 – Pre and Post-Construction Inspections
- B. Section SS 01520 – Geotechnical Instrumentation and Monitoring
- C. Section SS 02410 – General Tunneling Requirements
- D. Section SS 02411 – Tunneling with an Earth Pressure Balance Machine (EPBM)
- E. Section SS 02412 – Tunneling with Non-Pressurized Shielded TBM
- F. Section SS 02413 – Hand Mining
- G. Section SS 02420 – Steel Liner Plate
- H. Section SS 02421 – Precast Concrete Segmental Liner
- I. Section SS 02422 – Shotcrete
- J. Section SS 02430 – Installation of Pipe in Tunnel
- K. Section SS 02432 – Contact Grouting
- L. Section SS 02440 – General Shaft Requirements
- M. Section SS 02441 – Secant Pile Walls
- N. Section SS 02442 – Dewatering and Control of Groundwater for Shafts and Tunnels

### 1.03 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. The applicable provisions of the following standards and codes shall apply as if written here in their entirety:
  - 1. American Concrete Institute (ACI):
    - a. 214 – Recommended Practice for Evaluation of Strength Test Results of Concrete.
    - b. 523.1R, Guide for Cast-in-Place Low-Density Concrete.
    - c. 523.3R, Guide for Cellular Concretes Above 50 pcf, and for Aggregate Concretes above 50 pcf with Compressive Strengths Less-than 2500 psi.
  - 2. American National Standards Institute (ANSI): ANSI-B40.1 – Gauge - Pressure, Indicating Dial Type – Elastic Element.
  - 3. American Society for Testing and Materials (ASTM):
    - a. C33 – Specification for Concrete Aggregates.

- b. C94 – Standard Specification for Ready-Mixed Concrete.
- c. C109 – Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.
- d. C117 – Test Method for Material Finer than 75  $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing.
- e. C136 – Method for Sieve Analysis of Fine and Coarse Aggregates
- f. C138 – Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.
- g. C150 – Specifications for Portland Cement.
- h. C231 – Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
- i. C260 – Specification for Air-Entraining Admixtures for Concrete.
- j. C311 – Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.
- k. C403 – Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
- l. C494 – Specification for Chemical Admixtures for Concrete.
- m. C495 – Standard Test Method for Compressive Strength of Lightweight Insulating Concrete.
- n. C567 – Standard Test Method for Unit Weight of Structural Lightweight Concrete.
- o. C618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
- p. C796 – Standard Test Method for Foaming Agents for Use in Producing Cellular Concrete Using Preformed Foam.
- q. C869 – Standard Specification for Foaming Agents Used in Making Preformed Foam for Cellular Concrete.

#### 1.04 DEFINITIONS

- A. Low-Density Cellular Concrete: A lightweight cementitious material that contains stable air or gas cells uniformly distributed throughout the mixture and with a minimum air percentage of 20 percent.

#### 1.05 QUALITY ASSURANCE AND QUALITY CONTROL

- A. Quality Control Plans:
  - 1. Procedures for producing cellular concrete, including procedures for verifying mix ingredient quality and performing sampling, testing, and record keeping.
  - 2. Methods for controlling critical mix parameters, such as cellular concrete density.
  - 3. Methods for assuring that the annular space between the carrier pipe and the initial support is filled completely.
  - 4. Methods for assuring that injection pressures and heat of hydration do not damage adjacent work or the carrier pipe.
  - 5. Method for determining when pipe bracing and supports may be removed.
- B. Qualifications:
  - 1. Cellular Concrete Specialty CONTRACTOR: Minimum of five years of recent, successful experience in batching and placing cellular concrete for at least three tunnel projects of the general type, size, and diameter as required for this project.
  - 2. Concrete Supervisor: Minimum of one-year experience in similar tunnel conditions and knowledgeable in the formulation and adjustment of mix designs.



3. Field Sampling and Testing Personnel: Qualified employees possessing relevant ACI Certifications and testing performed by an ACI-certified testing laboratory.
- C. Acceptance Criteria:
1. Compression Tests: Evaluate and accept in accordance with ACI 214.
  2. Density: At or above the specified minimum density and within 10 percent of the design value.
- D. Preconstruction Meeting:
1. The CONTRACTOR shall schedule a meeting with the OWNER's REPRESENTATIVE to be held from 30 to 60 days before the start of annular backfilling. Using the accepted submittal as a guide to the discussion, the following topics will be reviewed at the meeting:
    - a. Scope of the Work to be performed.
    - b. Construction methods and constraints.
    - c. Equipment operating parameters.
    - d. Safety procedures.
    - e. Quality control procedures and quality assurance requirements.
    - f. Reporting requirements.
    - g. Other issues.
- E. Testing:
1. General: Perform field control tests, including unit weight (wet density), temperature, and compression tests, and submit the results submitted to the ENGINEER and OWNER's REPRESENTATIVE.
  2. Test cellular concrete compressive strength in accordance with ASTM C495, and mimicking in-situ pressures except that cylinders shall be cast using Styrofoam molds. Plastic molds will not be permitted. Test specimen shall not be oven cured. Specimen shall be capped with plaster of Paris, not sulfur caps.
    - a. Pre-Production Testing: Take one set comprising four concrete cylinders for each proposed mix. Perform compressive strength tests on one set of samples at 28 days.
    - b. Production Testing: Take one set of four test cylinders at the placement location for each shift when cellular concrete is placed. Make one additional set from each additional 200 cubic yards, or major fraction thereof, placed in any one shift. Perform compressive strength tests on a minimum of two samples at 28 days.
  3. CONTRACTOR may opt at no additional cost to the OWNER to collect additional samples and test at earlier dates to verify minimum design strengths are met.
  4. Monitor the temperature rise during curing of backfill materials to confirm that the specified criteria have been achieved. Measure the temperature of the pipe after placement of each lift of backfill at the following times: immediately after placement, 30 minutes, one hour, two hours and four hours.
  5. Conduct wet density tests, in accordance with ASTM C567, on samples collected at the injection point every 60 minutes, after a change in the mix batched, and whenever compression test cylinders are made.
- F. Source Quality Control:
1. The CONTRACTOR shall provide delivery and measurement of materials from batching equipment to within the accuracies specified in ASTM C94. Scales shall be tested periodically in a manner and at intervals set forth in the accepted submittals.
  2. Fly ash shall be sampled and tested in accordance with ASTM C311 at least once daily.
  3. Mix design tickets shall be provided for cellular concrete backfill used each day, identifying the mix design criteria.

4. Delivery tickets for each load of backfill concrete shall be provided in accordance with ASTM C94.
- G. Field Quality Control:
1. General: Collect samples of fresh cellular concrete at the injection point or discharge point. Measure and record the volume of backfill placed. Compare actual volume placed for each length of tunnel being backfilled with the theoretical volume for that length of tunnel being backfilled. Use grout hole connections in the pipe to monitor the backfill placement operations.
  2. Compression Tests: Take two sets of two cylinders for every 200 cubic-yard batched, but no less than two sets per day, two sets per annulus between carrier pipe and tunnel liner/casing grouted, or two sets per lift. Test two cylinders at 28 days and test the additional two cylinders at 56 days.
  3. Heat of Hydration Monitoring: Monitor the temperature rise during curing of backfill materials to confirm that the specified criteria have been achieved. Measure the temperature of the pipe after placement of each lift of backfill at the following times: immediately after placement, 30 minutes, one hour, two hours, and four hours. If the temperature has not leveled at the 4 hours point, then continue monitoring temperatures until the temperatures begin to decrease. Ensure that the pipe temperature does not exceed the manufacturers specified limits provided in the CONTRACTORS submittal for the FRP carrier pipe.
  4. Wet Density Test for Cellular Concrete: Sample at the injection point every 30 minutes, after a change in the mix batched, and whenever compression test cylinders are made. Equipment used to generate foam for cellular concrete shall be tested and calibrated each day for density and volume output.

## 1.06 SUBMITTALS

- A. Submittals shall be in accordance with Section SS 01300 – Submittals.
- B. Calculations required in submittals shall be sealed by a Professional Engineer licensed in the State of Texas.
- C. Provide Working Drawings and Methods Statements for low density cellular concrete, including:
  1. Means and methods for proportioning, mixing, batching, and delivering concrete or grout, including the storage of raw materials.
  2. Details for transporting, placing, and consolidating concrete or grout. Integrate with and describe the sequencing of this work with the installation of pipe as specified in Section SS 02430 – Installation of Pipe in Tunnel.
  3. Lift drawings showing details of delivery pipes, slicklines, injection ports, break between pour bulkheads/construction joints, casing seals or tunnel end bulkheads, and other materials. Details of construction joints and methods to ensure complete filling of voids and voids left by shrinkage of backfill concrete materials.
  4. Calculations, stamped by Texas registered Professional Engineer, for preventing flotation and deformation of the final lining (carrier pipe). Provide calculation for each lift planned to place backfill.
  5. Descriptions of labor, equipment and supplies required to perform the work.
  6. Cross-sections and profiles showing the arrangement of transportation, handling, and placing equipment including passing clearances.

7. Details of pumping pressures and rates, placement sequences and volumes, lift thicknesses, including the theoretical quantity for each placement.
  8. Methods for diverting construction water and groundwater and protecting concrete or grout.
  9. Ensure that the pipe temperature during annular backfilling does not exceed the manufacturers specified limits provided in the CONTRACTORS submittal for the FRP carrier pipe. The CONTRACTOR shall provide the pipe manufacturers maximum temperature as part of this submittal.
  10. Quantities of grout to be placed for each placement.
- D. Mix Designs: The CONTRACTOR shall submit concrete or grout mix designs that include test data (air content, 28-day strength tests, and unit weight), cement gradation criteria, weights and quantities of materials.
- E. Quality Control:
1. Qualifications: The CONTRACTOR shall provide information regarding the proposed specialty firm for batching and pumping cellular concrete, the individuals responsible for development of mix designs, and the individuals overseeing placement, field sampling and testing of the cellular concrete.
  2. Certifications:
    - a. Certificates of compliance for materials incorporated into the Work.
    - b. Calibration certificates for gauges, scales, and meters in accordance with ANSI B40.1.
    - c. Written certification from the pipe manufacturer that the pipe can handle the proposed pumping and hydrostatic pressures.
    - d. Written certification from the manufacturer of the foaming agent material manufacturer that: (1) ingredients used in cellular concrete are compatible, (2) the method whereby the cellular concrete foaming agent is introduced to the batching system is acceptable, and (3) that the concreting supervisor is knowledgeable in the formulation and adjustment of mix designs.
- F. Recordkeeping: Daily records shall be submitted no later than the end of each working day for the following:
1. Delivery tickets.
  2. Daily reports and records of cellular concrete placement, including:
    - a. Number and classification of personnel and equipment.
    - b. Beginning and ending stations or elevations of placements.
    - c. Beginning and ending time for the placements.
    - d. Volumes placed and lift (stage) heights achieved.
    - e. Test information, including times, temperatures, locations, and results of tests.
    - f. Notation of any downtime or interruption to production, including length of time and reason.
    - g. Notifications: 24 hours in advance of (excluding non-work days) all placements.

## 1.07 GENERAL REQUIREMENTS

### A. Design Criteria

1. Low Density Cellular Concrete:
  - a. Cement content shall be no less than 200 lb/cy.
  - b. Water cement ratio shall be no more than 0.55.
  - c. Wet density shall be no less than 40 lb/cubic ft.

- d. Minimum compressive strengths shall be 150 psi after seven days and 300 psi after 28-days.
  2. Backfill Concrete Joints: Joints may be sloping joints or oriented perpendicular to the longitudinal centerline of the pipe to provide for complete filling of all voids.
- B. Sequencing and Scheduling
1. The CONTRACTOR shall notify the OWNER's REPRESENTATIVE and ENGINEER prior to the commencement of activities related to this specification.
  2. The CONTRACTOR shall provide access at all times to the OWNER's REPRESENTATIVE and ENGINEER to view and inspect the work specified herein.

## **PART 2 - PRODUCTS**

- A. Foaming Agent: Foaming agent shall conform to the requirements of ASTM C869 when tested in accordance with ASTM C796. The foaming agent shall maintain stability until the cement sets to form a self-supporting matrix comprising closed cells and low water absorptive characteristics.
- B. Admixtures: Admixtures shall not contain chlorides, substances that promote corrosion, and for cellular concrete, admixtures shall be certified for use with foaming agent by foaming agent manufacturer.
1. Air-entraining admixtures shall conform to ASTM C260, and shall be nontoxic after 30 days and shall contain no chlorides.
  2. Water-reducing admixtures shall conform to ASTM C494, Type A or D, shall contain no chlorides, shall be nontoxic after 30 days, and shall be compatible with the air-entraining admixtures. The amount of admixture added to the concrete shall be in accordance with the Manufacturer's recommendations.
- C. Retarder/Water Reducer: ASTM C494, Type D.
- D. Plasticizer/Water Reducer: ASTM C494, Type A.
- E. Cement: ASTM C150, Type II.
- F. Fly Ash: ASTM C618, Class F, except that fly ash with carbon content greater than 6 percent may be used.
- G. Water: ASTM C94, with a pH not less than 6.7.
- H. Grout ports: Provide 3-inch and 1-inch stainless grout ports installed by the pipe manufacturer and at the minimum spacing detailed in the Contract Drawings. CONTRACTOR may opt to install more grout ports at no additional cost to the OWNER.

## **PART 3 - EQUIPMENT**

- A. Equipment shall be of sufficient size and capacity to batch and pump required volumes of concrete backfill over the distance required and through injection ports at a uniform flow rate and under the required constant pressure in an underground environment. No trucking of concrete backfill is allowed. Equipment shall be maintained in good operating condition. An adequate inventory of spare parts and backup equipment shall be available on site.

- B. Cement slurry shall be batched mechanically in a manner ensuring consistency of the mix.
- C. Foam shall be generated by combining controlled quantities of air, water, and foaming agent under pressure in accordance with the foaming agent manufacturer's recommendations. The temperature of water used in generating the foam shall be maintained below 80°F, or as recommended by the foaming agent manufacturer. Foam shall be discharged into the mixer and blended with the cement slurry.
- D. The mixer shall be configured for compatibility with the pump to ensure continuous and uniform flow at the point of placement. The mixer shall be capable of providing a super-wetted, homogenized mix. The mixer shall be fitted with a meter with an accuracy of  $\pm 1$  gallon to measure the volume of water added to dry mix ingredients.
- E. Pumping equipment shall be capable of pumping concrete without pulsation or segregation. Pumping equipment shall be operated to convey a continuous, uniform stream of concrete without air pockets. Pumping equipment shall be equipped with a device to limit pumping pressure as required to prevent damage to the carrier pipe.
- F. Backfill shall be conveyed to placement points using steel piping or rubber hoses, of proper type and diameter to withstand maximum injection pressures used, and with all components having an internal diameter of at least 2-inches. A system of valves shall be furnished in the line at or near the points of injection to facilitate sample collection. Suitable stop valves shall be furnished at injection points for use in venting air or maintaining pressure, as required.
- G. Pressure gauges shall display up to 150 percent of the maximum allowable pressure and be accurate to within 0.5 percent over the full range of the gauge. Pressure gauges shall be certified and calibrated in accordance with ANSI B40.1, Grade 2A. Pressure gauges shall be oil-filled type gauges attached to a saddle-type diaphragm seal. Provide suitable valves and calibrated pressure gauges so that the pressure and grout flow at the grout hole may be regulated and monitored.

#### **PART 4 - EXECUTION**

- A. The limits of each backfill placement shall be established based on size and capacity of batching and placing equipment and mix parameters such as initial set time.
- B. Lift heights shall be limited to avoid damage and pipe flotation and to maintain cellular concrete parameters within specified limits.
- C. Utilities shall be arranged and routed to provide ready and available services during backfill placement.
- D. Temporary track systems used during tunnel construction may be left in place if the minimum indicated clearances are maintained and timber ties are removed.
- E. Verify that locations where backfill is to be placed are clean and free of standing or running water. If conditions warrant, operate dewatering systems until grouting operations are complete and grout has reached initial set. Where used, seal or otherwise protect sheeting, panning, and drainage systems from infiltration by backfill. Verify that the pipe has been installed as specified in Section SS 02430 – Installation of Pipe in Tunnel.

- F. Erect full-height vertical bulkheads snug between excavated rock surface or tunnel support system and pipe no closer than 12-inches from the leading edge of the pipe. Provide an opening in the crown in addition to other required vent outlets. Provide an opening for the tunnel invert drain and at the casing invert to facilitate draining water away from the work during backfilling operations.
- G. Methods employed shall completely fill the annular space behind the pipe with concrete. Where water inflows or zones of water seepage exceed two gallons per minute, erect panning to divert groundwater inflows away from backfill placement.
- H. Use methods as required to avoid pipe flotation and damage to the pipe. Inject concrete on either side of the pipe simultaneously. Complete sequencing in accordance with the submitted and reviewed backfilling sequence.
- I. Unless specified otherwise, install backfill through grout ports within the carrier pipe. Grout fittings/ports shall be fabricated into the carrier pipe. After grouting, all grout ports shall be sealed with a threaded plug (using thread compound or tape).

#### **PART 5 - MEASUREMENT AND PAYMENT**

Measurement and payment of items included in this section will be made on a per linear foot basis for:

1. Contact Grouting and Annular Backfill behind the 104" carrier pipe; and
2. Contact Grouting and Annular Backfill behind the 60" carrier pipe.

**END OF SECTION**

**Exhibit “C”**  
**SECURITY PROCEDURES**

If work will be conducted on SAWS property, on SAWS infrastructure, on a SAWS customer’s property, or involve any SAWS networks, or any SAWS facility, the Contractor shall provide background screening information of their employees and sub-contractors to CastleBranch, the SAWS-approved vendor of background screening services, at [sawsbackgroundcheck@castlebranch.com](mailto:sawsbackgroundcheck@castlebranch.com). Any person found to have an unacceptable background check will not be allowed to perform work under this Contract (however, at SAWS’s sole discretion, a waiver may be given by SAWS Security for an unacceptable finding, provided that it must first be approved and signed off on by the Director of SAWS Security). Any sub-contractors performing work must also receive a background screening by CastleBranch. Contractor shall be responsible for the accuracy of information on the background screening information sent to [sawsbackgroundcheck@castlebranch.com](mailto:sawsbackgroundcheck@castlebranch.com). For further questions about background screening, call CastleBranch at 910-679-2979 or 888-723-4263 ext. 7857 and advise them the Contractor is working for SAWS. Once background screening is approved by SAWS Security, Contractor must also complete a Project Contractor Data Form (“PCDF”). The PCDF will be sent to [securitygroup@saws.org](mailto:securitygroup@saws.org). The PCDF is required for the Contractor and its sub-contractors to receive the required badges and parking tags necessary to fulfill the work under this Contract. The PCDF must be sent electronically to [securitygroup@saws.org](mailto:securitygroup@saws.org).

Each employee and agent of Contractor shall obtain a SAWS photo identification badge (a “Contractor's Badge”) and parking tag prior to any work on SAWS property or asset, which shall be used only for purposes necessary to perform the work under this Contract. SAWS Badge Office hours are Monday, Wednesday and Friday from 9:00am to 12:00pm, excluding SAWS holidays (hours are subject to change). SAWS Security staff can be contacted at (210) 233-3177 or (210) 233-3338. Once the Project is completed, the Contractor shall return all Contractor Badges and parking tags to the Security Office. A Contractor who does not return the

Contractor Badges or parking tags is not in compliance with these procedures.

SAWS facilities require a SAWS employee to physically escort the Contractor at all times. SAWS may, at its sole discretion, waive the escort requirements if the PCDF and a “clean” background screening from CastleBranch are approved. Waiver of the escort requirement shall only be through a written correspondence to Contractor from SAWS Security.

Sub-contractors must always be under escort of Contractor while performing work on any SAWS property or asset. Sub-contractors must display the Contractor’s Badge at all times while working on any SAWS property or asset. Sub-contractors are required to complete a background screening and be listed on the PCDF regardless of receiving a Contractor’s Badge. The Contractor is solely responsible for the actions of its employees, agents, sub-contractors and consultants.

Contractor shall advise their SAWS Project Manager/Inspector of any employee terminations or changes to personnel performing work under this Contract, and the Contractor shall immediately turn in any and all Contractor’s Badges and/or parking tags of employees or agents who are terminated or no longer performing work under this Contract. If Contractor becomes aware of any changes in the information contained in the PCDF or the background screening information, Contractor shall immediately notify the SAWS Project Manager/Inspector and provide an updated PCDF to [securitygroup@saws.org](mailto:securitygroup@saws.org) and background screening information to [sawsbackgroundcheck@castlebranch.com](mailto:sawsbackgroundcheck@castlebranch.com).

Contractor is responsible for being in compliance with SAWS Security requirements and for maintaining security of SAWS property, infrastructure, SAWS customer’s property, networks, and facilities for the length of the Project. Security incidents must be reported to SAWS Security immediately at (210) 233-3338.



If the Contractor plans to leave the site unsecure or open during the Project, they must provide a SAWS-approved security guard to monitor ingress and egress to the SAWS site.

If Contractor takes any action that diminishes the security of a SAWS site, Contractor will be responsible for providing additional security requirements at its expense. Some examples of additional requirements that SAWS may require include hiring of SAWS approved security guards, temporary fencing, mobile Closed Circuit Television Monitoring trailer(s), or extra lighting. Notwithstanding anything herein to the contrary, any provisions in these Security Procedures that may appear to give SAWS the right to direct Contractor as to details of doing any work under this Contract or to exercise a measure of control over any security measures or such work shall be deemed to mean that Contractor shall follow the desires of SAWS in the results of the work or security measures only.

Advance coordination by Contractor with SAWS Security for these security requirements is necessary to ensure no delays with timely performance of work. Any other provision of this Contract notwithstanding, in the event Contractor fails to comply with SAWS Security requirements, SAWS may, with no penalty, claim of any nature (including but not limited to breach of contract) against SAWS by the Contractor:

- Issue a Work Stoppage Order until the security violation (s) are remedied
- Ask any unidentified or improperly identified person or equipment to leave SAWS site immediately and not return until items or deficiencies are remedied to SAWS's satisfaction.

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## CIVIL

- C1 104-INCH SANITARY SEWER PLAN & PROFILE STA. 10+00 TO STA. 13+00
- C2 104-INCH SANITARY SEWER PLAN & PROFILE STA. 13+00 TO STA. 17+00
- C3 104-INCH SANITARY SEWER PLAN & PROFILE STA. 17+00 TO STA. 21+00
- C4 104-INCH SANITARY SEWER PLAN & PROFILE STA. 21+00 TO STA. 25+00
- C5 104-INCH SANITARY SEWER PLAN & PROFILE STA. 25+00 TO STA. 29+00
- C6 104-INCH SANITARY SEWER PLAN & PROFILE STA. 29+00 TO STA. 33+00
- C7 104-INCH SANITARY SEWER PLAN & PROFILE STA. 33+00 TO STA. 37+00
- C8 104-INCH SANITARY SEWER PLAN & PROFILE STA. 37+00 TO STA. 41+00
- C9 104-INCH SANITARY SEWER PLAN & PROFILE STA. 41+00 TO STA. 45+00
- C10 104-INCH SANITARY SEWER PLAN & PROFILE STA. 45+00 TO STA. 49+00
- C11 104-INCH SANITARY SEWER PLAN & PROFILE STA. 49+00 TO STA. 53+00
- C12 104-INCH SANITARY SEWER PLAN & PROFILE STA. 53+00 TO STA. 57+00
- C13 104-INCH SANITARY SEWER PLAN & PROFILE STA. 57+00 TO STA. 61+00
- C14 104-INCH SANITARY SEWER PLAN & PROFILE STA. 61+00 TO STA. 65+00
- C15 104-INCH SANITARY SEWER PLAN & PROFILE STA. 65+00 TO STA. 69+00
- C16 104-INCH SANITARY SEWER PLAN & PROFILE STA. 69+00 TO STA. 73+00
- C17 104-INCH SANITARY SEWER PLAN & PROFILE STA. 73+00 TO STA. 77+00
- C18 104-INCH SANITARY SEWER PLAN & PROFILE STA. 77+00 TO STA. 81+00
- C19 104-INCH SANITARY SEWER PLAN & PROFILE STA. 81+00 TO STA. 85+00
- C20 104-INCH SANITARY SEWER PLAN & PROFILE STA. 85+00 TO STA. 89+00
- C21 104-INCH SANITARY SEWER PLAN & PROFILE STA. 89+00 TO STA. 93+00
- C22 104-INCH SANITARY SEWER PLAN & PROFILE STA. 93+00 TO STA. 97+00
- C23 104-INCH SANITARY SEWER PLAN & PROFILE STA. 97+00 TO STA. 101+00
- C24 104-INCH SANITARY SEWER PLAN & PROFILE STA. 101+00 TO STA. 105+00
- C25 104-INCH SANITARY SEWER PLAN & PROFILE STA. 105+00 TO STA. 109+00
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- C48 104-INCH SANITARY SEWER PLAN & PROFILE STA. 197+00 TO STA. 201+00
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- C57 104-INCH SANITARY SEWER PLAN & PROFILE STA. 233+00 TO STA. 237+00
- C58 104-INCH SANITARY SEWER PLAN & PROFILE STA. 237+00 TO STA. 241+00
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- C62 104-INCH SANITARY SEWER PLAN & PROFILE STA. 253+00 TO STA. 257+00
- C63 104-INCH SANITARY SEWER PLAN & PROFILE STA. 257+00 TO STA. 261+00
- C64 104-INCH SANITARY SEWER PLAN & PROFILE STA. 261+00 TO STA. 265+00

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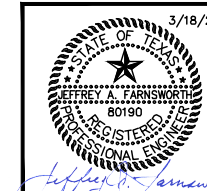
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- C67 104-INCH SAN. SEWER PLAN & PROFILE STA. 273+00 TO STA. 273+64.74
- C68 60-INCH SAN. SEWER PLAN & PROFILE STA. 273+64.74 TO STA. 277+00
- C69 60-INCH SANITARY SEWER PLAN & PROFILE STA. 277+00 TO STA. 281+00
- C70 60-INCH SANITARY SEWER PLAN & PROFILE STA. 281+00 TO STA. 285+00
- C71 60-INCH SANITARY SEWER PLAN & PROFILE STA. 285+00 TO STA. 289+00
- C72 60-INCH SANITARY SEWER PLAN & PROFILE STA. 289+00 TO STA. 293+00
- C73 60-INCH SANITARY SEWER PLAN & PROFILE STA. 293+00 TO STA. 297+00
- C74 60-INCH SANITARY SEWER PLAN & PROFILE STA. 297+00 TO STA. 299+00
- C75 78-INCH SANITARY SEWER PLAN & PROFILE STA. 1+00 TO END
- C76 8-INCH SAN. SEWER PLAN & PROFILE LINE B STA. 1+00 TO STA. 4+00
- C77 8-INCH SANITARY SEWER PLAN & PROFILE LINE B STA. 4+00 TO END
- C78 12-INCH SANITARY SEWER PLAN & PROFILE LINE C AND LINE D
- C79 12-INCH SANITARY SEWER PLAN & PROFILE LINE C STA. 3+50 TO END
- C80 15-INCH SANITARY SEWER PLAN & PROFILE LINE E STA. 1+00 TO END
- C81 12-INCH SANITARY SEWER PLAN & PROFILE LINE F STA. 1+00 TO END
- C82 8-INCH SANITARY SEWER PLAN & PROFILE LINE G STA. 1+00 TO END
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- C83A FLOW METER ELECTRICAL PLAN
- C83B ELECTRICAL DETAILS
- C84 24-INCH SANITARY SEWER SLIP LINE
- C84A W-6 MIDDLE CONNECTION FENCING RELOCATION
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- C88 SITE LAYOUT SHAFT #2 (PEARSALL RD)
- C89 SITE LAYOUT SHAFT #3 (MERRY OAKS)
- C90 SITE LAYOUT SHAFT #4 (WATER TOWER)
- C91 SITE LAYOUT SHAFT #5 (HOTEL)
- C92 SITE LAYOUT SHAFT #6 (SOLIDS HANDLING) & #7 (W-1 CONNECTION)
- C93 SITE LAYOUT SHAFT #8 (BALLPARK)

PLOTTED BY: WILSON, CONNER 3/17/2020 12:55 PM  
 DWG NAME: K:\SNA UTILITIES\068665052\CAD\SHSHEETS\COVERSHEET\_W-6.DWG  
 USER: WILSON

		3/18/2020 <b>Kimley»Horn</b> Texas Registered Firm, No. F-928 601 NW Loop 410 Suite 350 Tel No. 210-541-9166 San Antonio, TX 78216 Fax No. 210-541-8699	
No.	Revision	By	Date
⚠	ADDENDUM NO. 4	JAF	3/18/2020
 SAN ANTONIO WATER SYSTEM		<b>W-6 UPPER SEGMENT:                  HWY 90 TO SW MILITARY DR                  SEWER MAIN</b>  SHEET INDEX (SHEET 1 OF 2)	
DATE: MARCH 2020	SAWS PROJECT NO.	G2	
DESIGN: JKN	19-4519		
DRAWN: CRW	KHA PROJECT NO.		
CHECKED: JAF	068665052		

#	ITEM NO.	DESCRIPTION	UNIT	QUANTITY
1	103.1	REMOVE CONCRETE CURB (COSA SPEC)	LF	60
2	103.4	REMOVE MISCELLANEOUS CONCRETE	SF	813
3	C85A (1)	INSTALL TEMPORARY CHAIN-LINK WIRE FENCE	LF	150
4	C85A (2)	INSTALL CONCRETE COSA TRAIL	SY	89
5	C85	24' CANTILEVER MANUAL SLIDE GATE	EA	7
6	C85B	REMOVE AND RELOCATE JBSA PERIMETER FENCE	LF	365
7	104 6015	REMOVE CONC (SIDEWALKS) (TXDOT SPEC)	SY	456
8	104 6017	REMOVE CONC (DRIVEWAYS) (TXDOT SPEC)	SY	675
9	104 6021	REMOVE CONC (CURB) (TXDOT SPEC)	LF	1,615
10	105 6014	REMOVING STAB BASE & ASPH PAV (7"-12")	SY	295
11	200.1	FLEXIBLE BASE (6-INCH COMPACTED DEPTH) (COSA SPEC)	SY	6,015
12	203.1	TACK COAT (COSA SPEC)	GAL	694
13	205.2	HOT MIX ASPHALTIC PAVEMENT - TYPE B (10" COMPACTED DEPTH) (COSA SPEC)	SY	61
14	205.4	HOT MIX ASPHALTIC PAVEMENT - TYPE D (2" COMPACTED DEPTH) (COSA SPEC)	SY	6,936
15	208.1	SALVAGING, HAULING & STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (2" DEPTH) (COSA SPEC)	SY	6,720
16	209.1	CONCRETE PAVEMENT (12-INCH THICK) (COSA SPEC)	SY	6,015
17	300	ONE COURSE SURFACE TREATMENT (TXDOT SPEC)	SY	870
18	305 6002	SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (2" DEPTH) (TXDOT SPEC)	SY	1,645
19	305 6003	SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (4" DEPTH) (TXDOT SPEC)	SY	870
20	340	HOT MIX ASPHALTIC PAVEMENT - TYPE D (4-INCH COMPACTED DEPTH) (TXDOT SPEC)	SY	870
21	340 6272	TACK COAT (TXDOT SPEC)	GAL	167
22	341 6029	D-GR HMA TY-C SAC-A PG76-22 (2" COMPACTED DEPTH) (TXDOT SPEC)	TN	185
23	401	FLOWABLE FILL (TXDOT SPEC)	CY	1,471
24	464 6003	RC PIPE (CL III) (24-INCH) (TXDOT SPEC)	LF	20
25	467 6359	SET (TY II) (24-INCH) (RCP) (4:1) (P) (TXDOT SPEC)	EA	4
26	500.1	CONCRETE CURB (COSA SPEC)	LF	60
27	502 6025	BARRICADES, SIGNS, AND TRAFFIC HANDLING (TXDOT SPEC)	LS	1
28	529 6002	CONC CURB (TY II) (TXDOT SPEC)	LF	1,184
29	529 6025	CONC CURB (TY III) (TXDOT SPEC)	LF	238
30	530 6004	DRIVEWAYS (CONC) (TXDOT SPEC)	SY	1,979
31	531 6002	CONC SIDEWALKS (5-INCH) (TXDOT SPEC)	SY	421
32	SP540	TEMPORARY EROSION, SEDIMENT, AND WATER POLLUTION PREVENTION AND CONTROL (COSA SPEC)	LS	1
33	540.7	CONSTRUCTION PERIMETER FENCE (COSA SPEC)	LF	13,850
34	550.1	TRENCH EXCAVATION SAFETY PROTECTION (COSA SPEC)	LF	1,132
35	636 6001	ALUMINUM SIGNS (TY A) (TXDOT SPEC)	EA	14
36	644 6068	RELOCATE SM RD SN SUP&AM TY 10BWG (TXDOT SPEC)	EA	2
37	845	GATE, FENCING, AND PROPERTY MARKER DETAILS	LF	2,140
38	848A	8-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (10'-14' DEPTH)	LF	10
39	848A	8-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (14'-18' DEPTH)	LF	57
40	848A	8-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (18'-22' DEPTH)	LF	13
41	848A	12-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (6'-10' DEPTH)	LF	48
42	848A	12-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (10'-14' DEPTH)	LF	55
43	848A	12-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (14'-18' DEPTH)	LF	152
44	848A	12-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (18'-22' DEPTH)	LF	89
45	848A	12-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM 2241) (22'-26' DEPTH)	LF	92
46	848A	15-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM F679, 46 PSI) (10'-14' DEPTH)	LF	70
47	848A	24-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM F679) (6'-10' DEPTH)	LF	38
48	848A	24-INCH PVC GRAVITY SANITARY SEWER PIPE (ASTM F679) (10'-14' DEPTH)	LF	42
49	848B	SANITARY SEWERS - PIPE TESTING AND ACCEPTANCE	LS	1
50	853A	FIBER-REINFORCED SANITARY SEWER MANHOLE (4' DIAMETER)	EA	10
51	853A	FIBER-REINFORCED SANITARY SEWER MANHOLE W/ DROP (4' DIAMETER)	EA	4
52	853A	FIBER-REINFORCED SANITARY SEWER MANHOLE - TEE BASE FIBERGLASS MANHOLE, MITER (5' DIAMETER)	EA	1
53	853A	FIBER-REINFORCED SANITARY SEWER MANHOLE - TEE BASE FIBERGLASS MANHOLE W/ DROP, MITER (12' DIAMETER)	EA	2
54	853A	EXTRA DEPTH (>6') FIBERGLASS MANHOLE (4' DIAMETER)	VF	135
55	853A	EXTRA DEPTH (>6') TEE BASE FIBERGLASS MANHOLE, MITER (5' DIAMETER)	VF	22
56	853A	EXTRA DEPTH (>6') TEE BASE FIBERGLASS MANHOLE, MITER (12' DIAMETER)	VF	47
57	853B	FIBER-REINFORCED SANITARY SEWER MANHOLES - MANHOLE TESTING AND ACCEPTANCE	LS	1
58	855	RECONSTRUCTION OF EXISTING MANHOLES	EA	1
59	857	30-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (4'-6' DEPTH)	LF	60
60	857	60-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (25'-30' DEPTH)	LF	13
61	857	78-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (30'-35' DEPTH)	LF	8
62	857	78-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (35'-40' DEPTH)	LF	300
63	857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (22'-25' DEPTH)	LF	40
64	857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (25'-30' DEPTH)	LF	75
65	857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (30'-35' DEPTH)	LF	51
66	SP857	HOBAS PIPE MATERIAL ONLY (60-INCH, 78-INCH, & 104-INCH)	LS	1
67	858	CONCRETE ENCASEMENT, CRADLES, SADDLES AND COLLARS	CY	4
68	01520	GEOTECHNICAL INSTRUMENTATION AND MONITORING	LS	1
69	02410	GENERAL TUNNELING REQUIREMENTS HAND MINING (60-INCH FRP SANITARY SEWER)	LF	924
70	02410	GENERAL TUNNELING REQUIREMENTS TBM TUNNELING (104-INCH AND 60-INCH FRP SANITARY SEWER)	LF	27,664
71	02415	EXCAVATION VIA GUIDED BORING OR MICROTUNNEL (36-INCH)	LF	750
72	02415	INSTALLATION OF STEEL CASING PIPE (36-INCH)	LF	750
73	02415	CARRIER PIPE INSTALLED IN BORE/MICROTUNNEL CASING PIPE (8-INCH)	LF	378
74	02415	CARRIER PIPE INSTALLED IN BORE/MICROTUNNEL CASING PIPE (12-INCH)	LF	372
75	02430	INSTALLATION OF PIPE IN TUNNEL (60-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	2,523

#	ITEM NO.	DESCRIPTION	UNIT	QUANTITY
76	02430	INSTALLATION OF PIPE IN TUNNEL (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	26,200
77	02431	ANNULAR BACKFILL FOR CARRIER PIPE (60-INCH FRP (ASTM D-3262) (SN72) SANITARY SEWER)	LF	2,523
78	02431	ANNULAR BACKFILL FOR CARRIER PIPE (104-INCH FRP (ASTM D-3262) (SN72) SANITARY SEWER)	LF	26,130
79	02440	GENERAL SHAFT REQUIREMENTS (W-6 MIDDLE SEGMENT SHAFT)	LS	1
80	02440	GENERAL SHAFT REQUIREMENTS (PEARSALL SHAFT)	LS	1
81	02440	GENERAL SHAFT REQUIREMENTS (MERRY OAKS SHAFT)	LS	1
82	02440	GENERAL SHAFT REQUIREMENTS (WATER TOWER SHAFT)	LS	1
83	02440	GENERAL SHAFT REQUIREMENTS (HOTEL SHAFT)	LS	1
84	02440	GENERAL SHAFT REQUIREMENTS (SOLIDS HANDLING SHAFT)	LS	1
85	02440	GENERAL SHAFT REQUIREMENTS (W-1 CONNECTION SHAFT)	LS	1
86	02440	GENERAL SHAFT REQUIREMENTS (BALLPARK SHAFT)	LS	1
87	02440	GENERAL SHAFT REQUIREMENTS (CALLAGHAN SHAFT)	LS	1
88	02600	POLYMER CONCRETE SANITARY SEWER MANHOLE, DROP (12' DIAMETER) (ALL DEPTHS)	EA	1
89	02610	STEEL CASING - (48-INCH)(0.625-INCH THICK)	LF	167
90	862.1	ABANDON - SANITARY SEWER MAIN (54-INCH)	LF	5,533
91	862.1	ABANDON - SANITARY SEWER MAIN (48-INCH)	LF	447
92	862.1	ABANDON - SANITARY SEWER MAIN (15-INCH)	LF	910
93	862.1	ABANDON - SANITARY SEWER MAIN (12-INCH)	LF	526
94	862.1	ABANDON - SANITARY SEWER MAIN (10-INCH)	LF	178
95	862.1	ABANDON - SANITARY SEWER MAIN (8-INCH)	LF	191
96	864-S1	BYPASS PUMPING SMALL DIAMETER SANITARY SEWERS (<24-INCH)	LS	1
97	864-S2	BYPASS PUMPING LARGE DIAMETER SANITARY SEWERS (≥24-INCH)	LS	1
98	866	SEWER MAIN TELEVISION INSPECTION (8-INCH TO 24-INCH)	LF	3,146
99	866	SEWER MAIN TELEVISION INSPECTION (30-INCH TO 60-INCH)	LF	8,503
100	866	SEWER MAIN TELEVISION INSPECTION (78-INCH TO 104-INCH)	LF	26,672
101	866A	EXISTING SEWER MAIN TELEVISION INSPECTION (8-INCH TO 24-INCH)	LF	1,737
102	866A	EXISTING SEWER MAIN TELEVISION INSPECTION (30-INCH TO 60-INCH)	LF	5,980
103	1100	SLIP-LINING SANITARY SEWERS(SLIPLINE 48" STEEL CASING W/ 24" )(10'-14' DEPTH)	LF	167
104	1100	SLIP-LINING SANITARY SEWERS(SLIPLINE EX. 54" W/ 48" STEEL CASING)(10'-14' DEPTH)	LF	160
105	11280	STAINLESS STEEL SLIDE GATES	LS	1
106	11310	PACKAGE METERING MANHOLE	LS	1
107	100	INTERMEDIATE DEMOBILIZATION BYPASS EQUIPMENT RENTAL	MD	20
108	100	INTERMEDIATE DEMOBILIZATION BYPASS PUMPING FUEL	MD	20
109	100	INTERMEDIATE DEMOBILIZATION BYPASS PUMPING WATCH	MD	20
110	02086	EXCAVATION, CLASSIFICATION, TRANSPORTATION, AND DISPOSAL OF TPH AFFECTED SOIL	TON	13,000
111	01030	W-1 CLEANING AND MAINTENANCE	LS	1
112	01020	TIME EXTENSION FOR W-1 BYPASS	AL	1
113	01020	ODOR CONTROL	AL	1
114	SC8.7	EARLY COMPLETION BONUS ALLOWANCE	AL	1
115	100A	INTERMEDIATE DEMOBILIZATION/REMOBILIZATION (OPEN CUT)	EA	1
116	100B	TBM MOBILIZATION (MAX 5% OF ITEMS 1 TO 106)	LS	1
117	100	MOBILIZATION (MAX 2% OF ITEMS 1 TO 106)	LS	1
118	101	PREPARING RIGHT-OF-WAY (MAX 1% OF ITEMS 1 TO 106)	LS	1



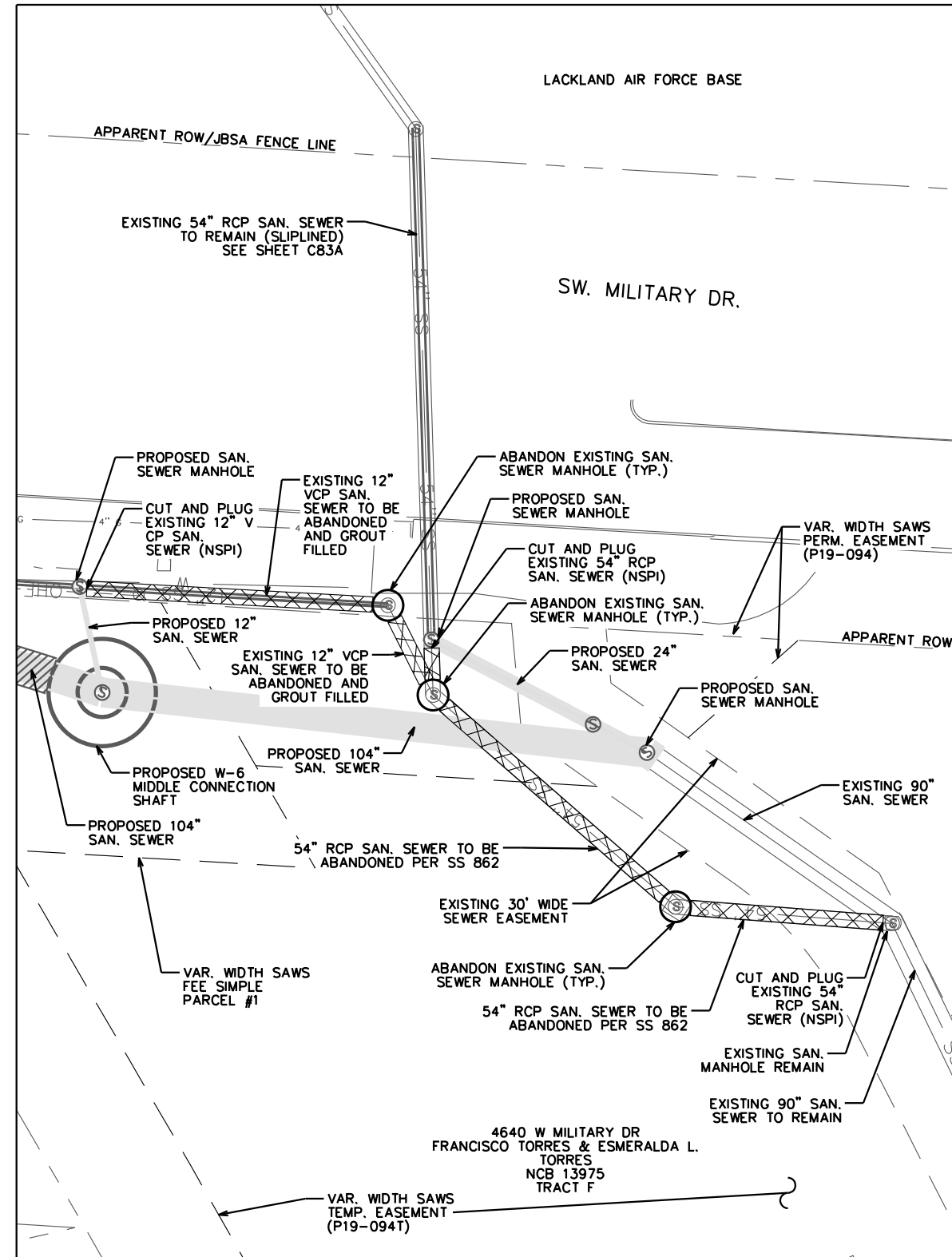
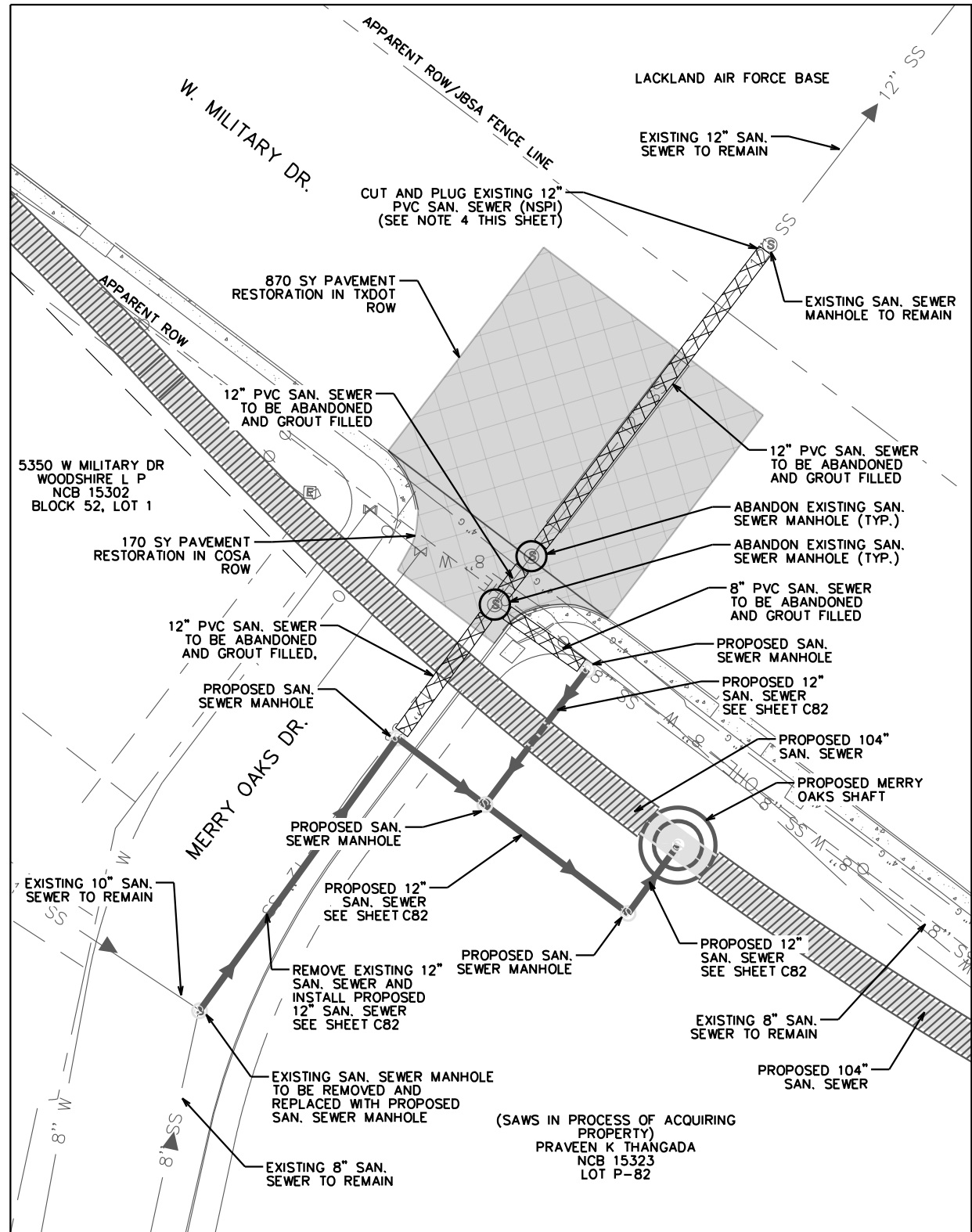
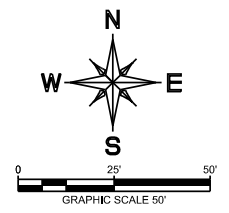
**Kimley»Horn**  
Texas Registered Firm, No. F-928  
601 NW Loop 410 Suite 350 Tel No. 210-541-9166  
San Antonio, TX 78216 Fax No. 210-541-8699

No.	Revision	By	Date
ADDENDUM NO. 1		JAF	3/9/2020
ADDENDUM NO. 4		JAF	3/18/2020

**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

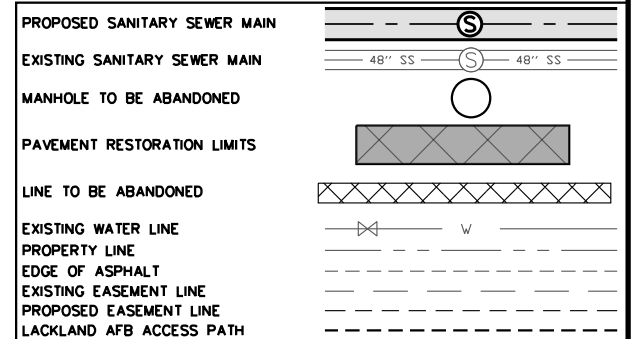
**OVERALL QUANTITIES**

DATE:	SAWS PROJECT NO.	SHEET NO.
MARCH 2020		G6
DESIGN: JKN	19-4519	
DRAWN: CRW	KHA PROJECT NO.	
CHECKED: JAF	068665052	



ESTIMATED QUANTITIES			
ITEM NO.	DESCRIPTION	UNIT	QUANTITY
203.1	TACK COAT (COSA SPEC)	GAL	17.00
205	HOT MIX ASPHALTIC PAVEMENT - TYPE D (2" COMPACTED DEPTH) (COSA SPEC)	SY	170.00
208	SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (2" DEPTH) (COSA SPEC)	SY	170.00
300	ONE COURSE SURFACE TREATMENT (TXDOT SPEC)	SY	870.00
305	SALVAGING, HAULING, AND STOCKPILING RECLAIMABLE ASPHALTIC PAVEMENT (4" DEPTH) (TXDOT SPEC)	SY	870.00
340	HOT MIX ASPHALTIC PAVEMENT - TYPE D (4" COMPACTED DEPTH) (TXDOT SPEC)	SY	870.00
862.1	ABANDON - SANITARY SEWER MAIN (54-INCH)	LF	194.00
862.1	ABANDON - SANITARY SEWER MAIN (12-INCH)	LF	341.00
862.1	ABANDON - SANITARY SEWER MAIN (8-INCH)	LF	123.00
866	SEWER MAIN TELEVISION INSPECTION (8-INCH TO 24-INCH)	LF	464.00
866	SEWER MAIN TELEVISION INSPECTION (30-INCH TO 60-INCH)	LF	194.00

**LEGEND**



DALE P. MURPHY  
PROFESSIONAL ENGINEER  
90614

**K. FRIESE + ASSOCIATES**  
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No.	Revision	By	Date
4	ADDENDUM NO. 4	DM	3/17/2020

**MERRY OAKS SHAFT**

- NOTES:
- ALL SAN. SEWER MAINS AND MANHOLES TO BE REMOVED FOR THE INSTALLATION OF PROPOSED MAINS AND MANHOLES WILL BE AT NO ADDITIONAL COST TO THE OWNER (NSPI).
  - ALL SAN. SEWER MAINS LOCATED IN TXDOT RIGHT-OF-WAY TO BE ABANDONED SHALL BE FILLED WITH GROUT, PER SAWS SPECIFICATION 862. ALL OTHER SAN. SEWER MAINS 15" OR GREATER IN DIAMETER TO BE ABANDONED SHALL BE FILLED WITH GROUT, PER SAWS SPECIFICATION 862.
  - CONTRACTOR SHALL BACKFILL AND REPAIR PAVEMENT/GRAVEL, PER SAWS AND/OR TXDOT SPECIFICATIONS, ASSOCIATED WITH THE REMOVAL OF EXISTING UTILITIES AT NO ADDITIONAL COST TO THE OWNER (NSPI).
  - CONTRACTOR SHALL REFER TO SHEET G33A FOR LACKLAND AIR FORCE BASE ACCESS ROUTE AND REQUIREMENTS.

**W-6 MIDDLE CONNECTION SHAFT**

SAN ANTONIO WATER SYSTEM

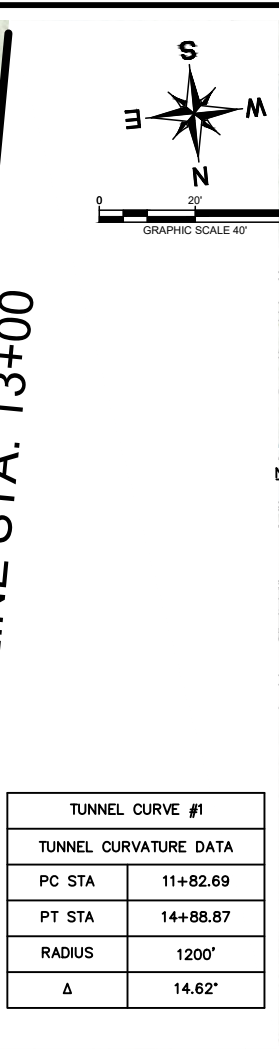
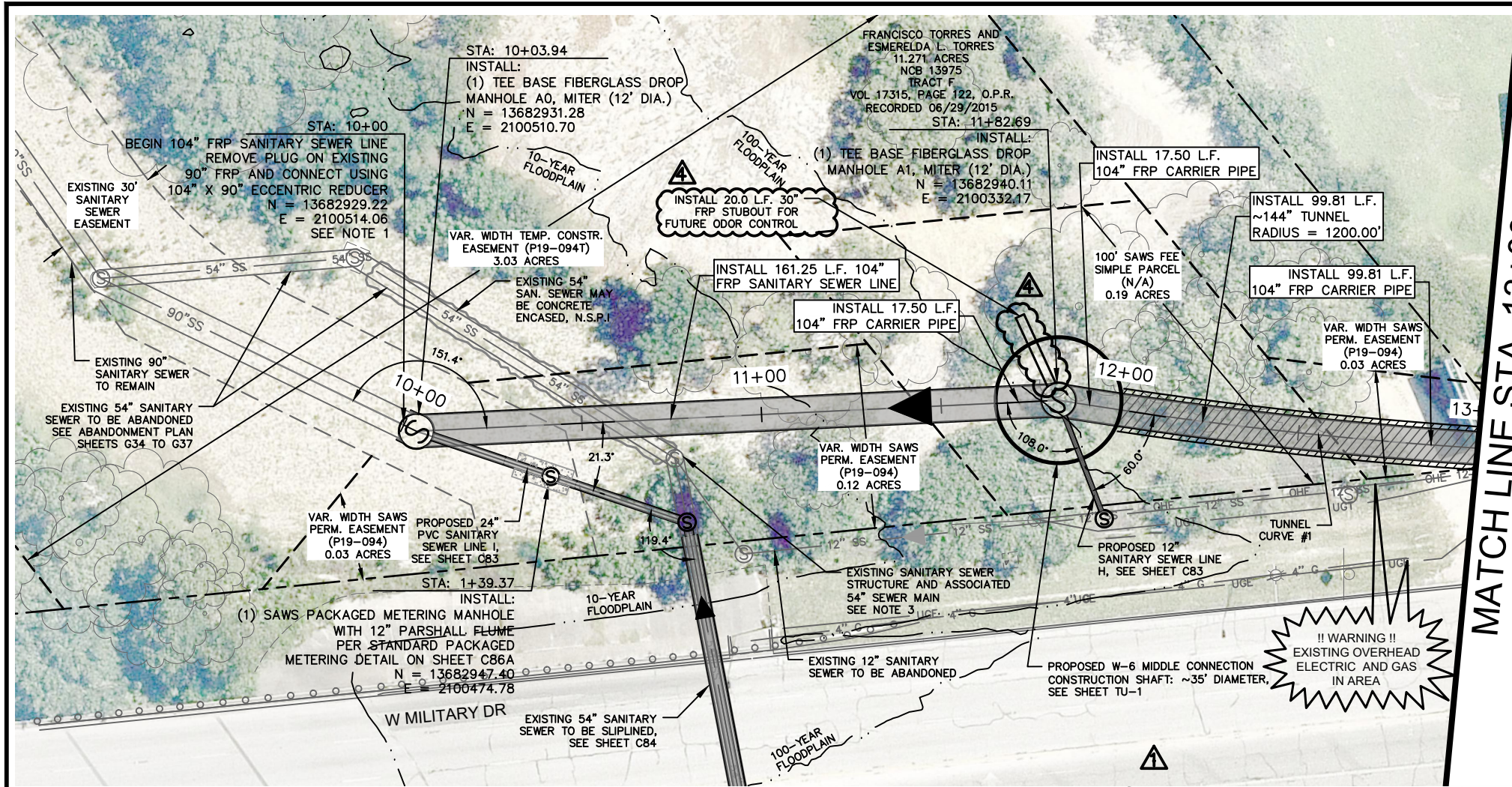
**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

SHEET

ABANDONMENT PLAN  
(SHEET 3 OF 4)

DATE: FEBRUARY 2020	SAWS PROJECT NO. 19-4519	G36
DESIGN: KFA	KHA PROJECT NO. 068665052	
DRAWN: KFA		
CHECKED: KFA		

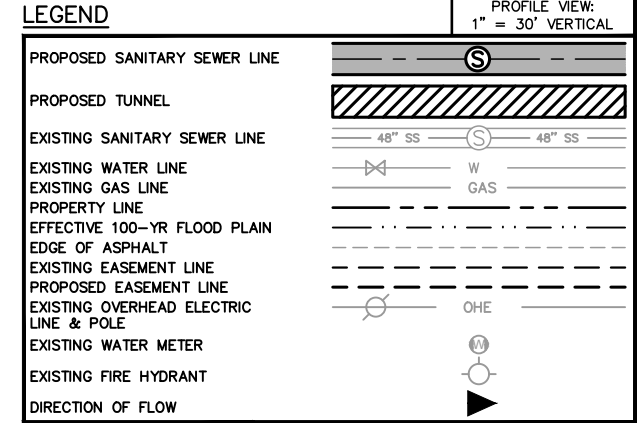
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ITEM NO.	DESCRIPTION	UNIT	QUANTITY
550.1	TRENCH EXCAVATION SAFETY PROTECTION (COSA SPEC)	LF	165.19
853A	FIBER-REINFORCED SANITARY SEWER MANHOLE - TEE BASE FIBERGLASS MANHOLE W/ DROP, MITER (12' DIAMETER)	EA	2
853A	EXTRA DEPTH (+6') TEE BASE FIBERGLASS MANHOLE, MITER (12' DIAMETER)	VF	46.18
857	30-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (4'-6" DEPTH)	LF	20
857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (22'-25" DEPTH)	LF	39.39
857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (25'-30" DEPTH)	LF	74.88
857	104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (30'-35" DEPTH)	LF	50.63
02410	GENERAL TUNNELING REQUIREMENTS TBM TUNNELING (104-INCH AND 60-INCH FRP SANITARY SEWER)	LF	99.81
02430	INSTALLATION OF PIPE IN TUNNEL (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	134.81
02431	ANNULAR BACKFILL FOR CARRIER PIPE (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	134.81
02440	GENERAL SHAFT REQUIREMENTS (W-6 MIDDLE SEGMENT SHAFT)	LS	1
866	SEWER MAIN TELEVISION INSPECTION (78-INCH TO 104-INCH)	LF	300

- NOTES:
- PRIOR TO COMMENCING PHASE 1 (SEE CONSTRUCTION SEQUENCING SHEET G29), CONTRACTOR SHALL LOCATE W-6 MIDDLE SEGMENT STUBOUT AND VERIFY ELEVATION. CONTRACTOR WILL NOT BE ALLOWED TO PROCEED TO FURTHER PHASES UNTIL THIS STUBOUT ELEVATION IS VERIFIED AND PROVIDED TO SAWS AND DESIGN ENGINEER.
  - DUE TO SOIL CONDITIONS BETWEEN STA. 11+83 AND STA. 24+75, THE USE OF PRESSURIZED FACE TUNNELING METHODS, INCLUDING GASKETED PRE-CAST CONCRETE SEGMENTS OR GASKETED LINER PLATE, IS REQUIRED (NSPI). REFERENCE THE GEOTECHNICAL BASELINE REPORT.
  - CONTRACTOR TO BE AWARE OF CLOSE PROXIMITY OF EXISTING SANITARY SEWER STRUCTURE AND ASSOCIATED 54" PIPE TO THE PROPOSED 104" PIPE. CONTRACTOR TO UTILIZE INSTALLATION MEANS AT THIS LOCATION TO ENSURE THE INTEGRITY OF THE STRUCTURE AND 54" PIPE SO THAT NO SEWER SPILLS OCCUR. PRIOR TO INSTALLATION OF THE 104" SEWER AT THIS LOCATION, CONTRACTOR SHALL SUBMIT PLAN FOR INSTALLATION FOR REVIEW BY SAWS AND DESIGN ENGINEER.
  - FOR CLARITY PURPOSES AND DUE TO THE DISTANCE BETWEEN EXISTING AND PROPOSED UTILITIES, EXISTING UTILITIES ARE ONLY SHOWN ON PROFILE WHERE THEY CROSS THE CENTER LINE ALIGNMENT OF THE PROPOSED PIPE.
  - FOR GEOTECHNICAL INSTRUMENTATION AND MONITORING REQUIREMENTS, SEE SHEET TU-1.
  - THREE-PHASE POWER WILL BE AVAILABLE FOR INSTALLATION AT SHAFT #1 - W-6 MIDDLE CONNECTION SHAFT. THE USE OF THREE-PHASE IS AT THE SOLE DISCRETION OF THE CONTRACTOR WHO MAY ELECT TO USE ALTERNATE MEANS AND METHODS OF POWER SUPPLY.

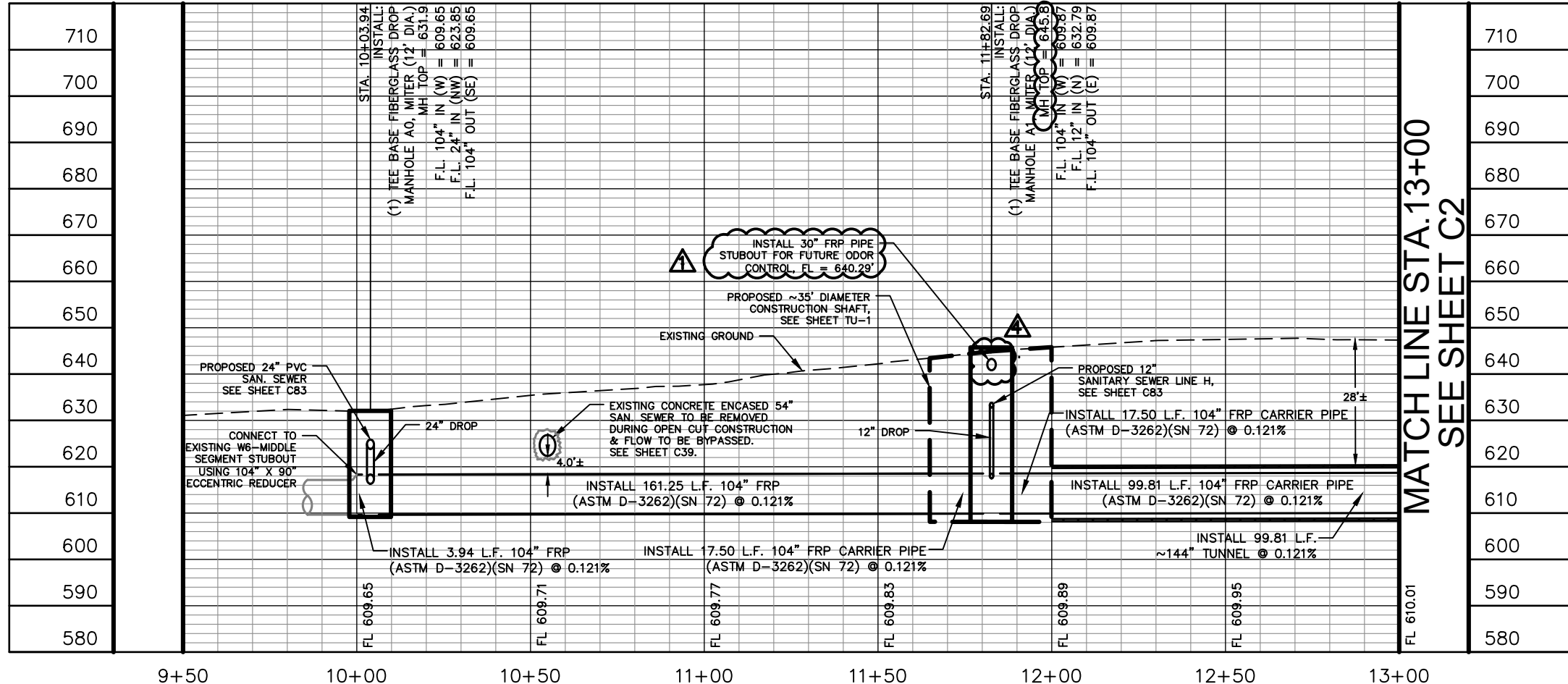
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TUNNEL CURVATURE DATA	
PC STA	11+82.69
PT STA	14+88.87
RADIUS	1200'
Δ	14.62'



3/18/2020

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No.	Revision	By	Date
Δ	ADDENDUM NO. 1	JAF	3/6/2020
Δ	ADDENDUM NO. 4	JAF	3/18/2020



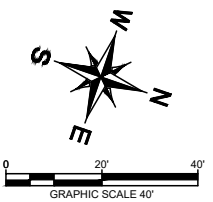
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SEE SHEET C2

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**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

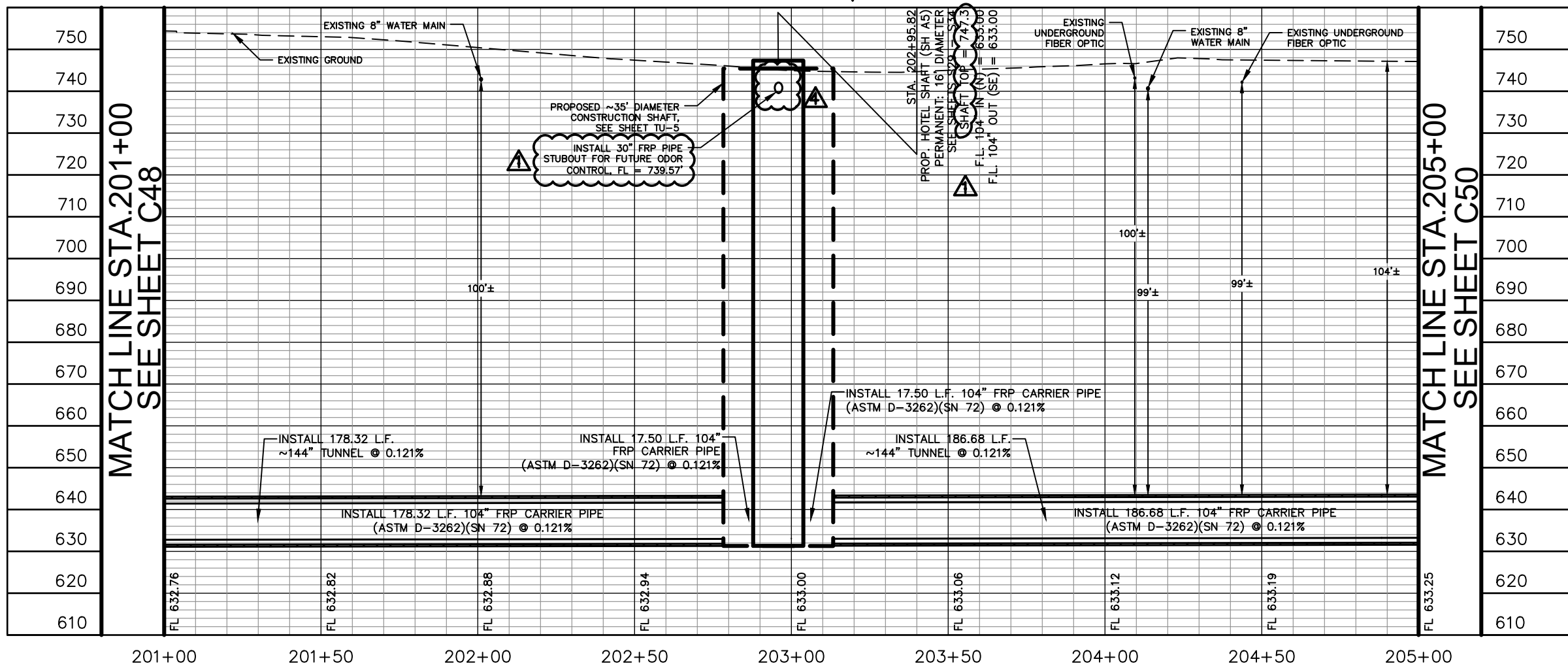
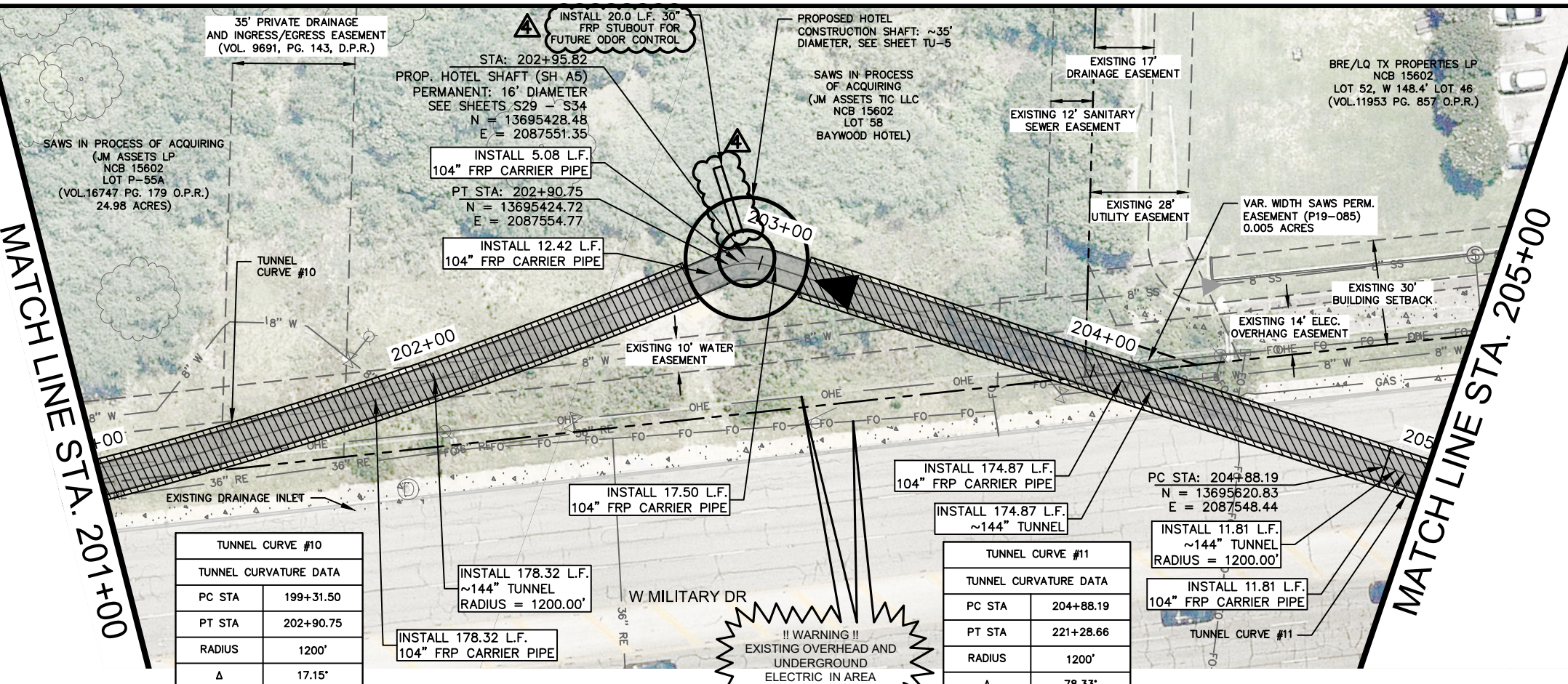
**104-INCH SANITARY  
SEWER PLAN & PROFILE  
STA. 10+00 TO STA.  
13+00**

DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. C1
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		



ITEM NO.	DESCRIPTION	UNIT	QUANTITY
857	30-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (4'-6" DEPTH)	LF	20
02410	GENERAL TUNNELING REQUIREMENTS TBM TUNNELING (104-INCH AND 60-INCH FRP SANITARY SEWER)	LF	365
02430	INSTALLATION OF PIPE IN TUNNEL (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	400
02431	ANNULAR BACKFILL FOR CARRIER PIPE (104-INCH FRP (ASTM D-3262) (SN72) SANITARY SEWER)	LF	365
02440	GENERAL SHAFT REQUIREMENTS (HOTEL SHAFT)	LS	1
866	SEWER MAIN TELEVISION INSPECTION (78-INCH TO 104-INCH)	LF	400

- NOTES:**
- FOR GEOTECHNICAL INSTRUMENTATION AND MONITORING REQUIREMENTS, SEE SHEET TU-5.
  - FOR CLARITY PURPOSES AND DUE TO THE DISTANCE BETWEEN EXISTING AND PROPOSED UTILITIES, EXISTING UTILITIES ARE ONLY SHOWN ON PROFILE WHERE THEY CROSS THE CENTER LINE ALIGNMENT OF THE PROPOSED PIPE.
  - THREE-PHASE POWER WILL BE AVAILABLE FOR INSTALLATION AT SHAFT #5 - HOTEL SHAFT. THE USE OF THREE-PHASE IS AT THE SOLE DISCRETION OF THE CONTRACTOR WHO MAY ELECT TO USE ALTERNATE MEANS AND METHODS OF POWER SUPPLY.



**LEGEND**

PROFILE VIEW: 1" = 30' VERTICAL

PROPOSED SANITARY SEWER LINE

PROPOSED TUNNEL

EXISTING SANITARY SEWER LINE

EXISTING WATER LINE

EXISTING GAS LINE

PROPERTY LINE

EFFECTIVE 100-YR FLOOD PLAIN

EDGE OF ASPHALT

EXISTING EASEMENT LINE

PROPOSED EASEMENT LINE

EXISTING OVERHEAD ELECTRIC LINE & POLE

EXISTING WATER METER

EXISTING FIRE HYDRANT

DIRECTION OF FLOW

3/18/2020

**Kimley»Horn**

Texas Registered Firm, No. F-928

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No.	Revision	By	Date
▲	ADDENDUM NO. 1	JAF	3/8/2020
▲	ADDENDUM NO. 4	JAF	3/18/2020

**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

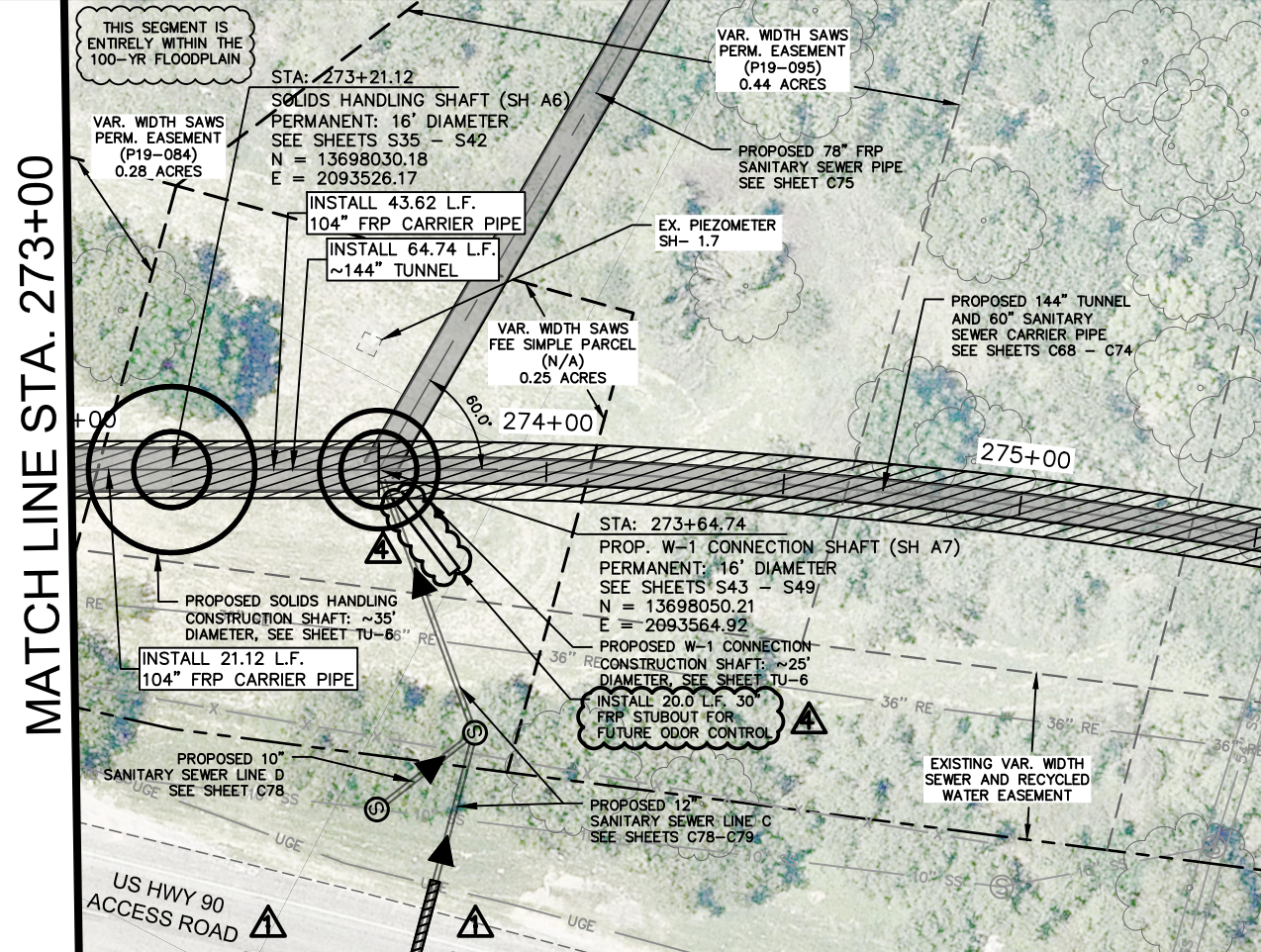
**104-INCH SANITARY  
SEWER PLAN & PROFILE  
STA. 201+00 TO STA.  
205+00**

SAN ANTONIO WATER SYSTEM

DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. C49
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		

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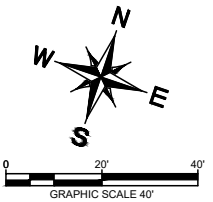
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 3/18/2020 11:47 AM



Station	Profile View	Notes
740		
730		
720		
710		
700		
690		
680		
670		
660		
650		
640		
630		
620		
610		
600		

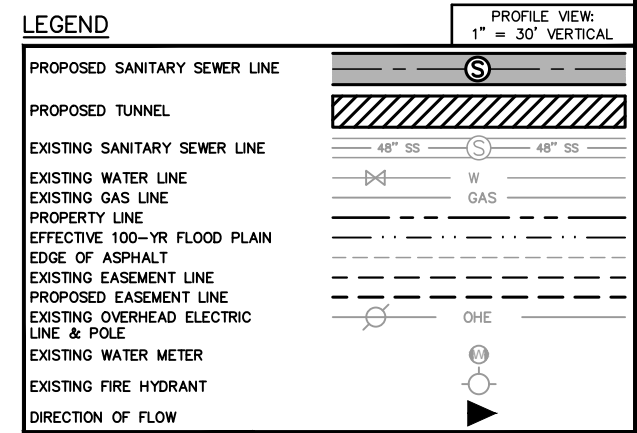
  

Station	Profile View	Notes
273+00	FL 641.47	
273+50	FL 641.53	
274+00		
274+50		
275+00		



ITEM NO.	DESCRIPTION	UNIT	QUANTITY
857	30-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER LINE (4'-6" DEPTH)	LF	20
02410	GENERAL TUNNELING REQUIREMENTS TBM TUNNELING (104-INCH AND 60-INCH FRP SANITARY SEWER)	LF	64.74
02430	INSTALLATION OF PIPE IN TUNNEL (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	64.74
02431	ANNULAR BACKFILL FOR CARRIER PIPE (104-INCH FRP (ASTM D-3262) (SN 72) SANITARY SEWER)	LF	64.74
02440	GENERAL SHAFT REQUIREMENTS (SOLIDS HANDLING SHAFT)	LS	1
02440	GENERAL SHAFT REQUIREMENTS (W-1 CONNECTION SHAFT)	LS	1
866	SEWER MAIN TELEVISION INSPECTION (78-INCH TO 104-INCH)	LF	64.74

- NOTES:**
- DUE TO SOIL CONDITIONS BETWEEN STA. 273+65 AND STA. 280+65, THE USE OF PRESSURIZED FACE TUNNELING METHODS, INCLUDING GASKETED PRE-CAST CONCRETE SEGMENTS OR GASKETED LINER PLATE, IS REQUIRED (NSPI). REFERENCE THE GEOTECHNICAL BASELINE REPORT.
  - FOR GEOTECHNICAL INSTRUMENTATION AND MONITORING REQUIREMENTS, SEE SHEET TU-6.
  - FOR CLARITY PURPOSES AND DUE TO THE DISTANCE BETWEEN EXISTING AND PROPOSED UTILITIES, EXISTING UTILITIES ARE ONLY SHOWN ON PROFILE WHERE THEY CROSS THE CENTER LINE ALIGNMENT OF THE PROPOSED PIPE.
  - THREE-PHASE POWER WILL NOT BE AVAILABLE TO SHAFT #6 - SOLIDS HANDLING SHAFT AND SHAFT #7 - W-1 CONNECTION SHAFT. POWER SUPPLY AT THESE SHAFT LOCATIONS IS THE SOLE RESPONSIBILITY OF THE CONTRACTOR.



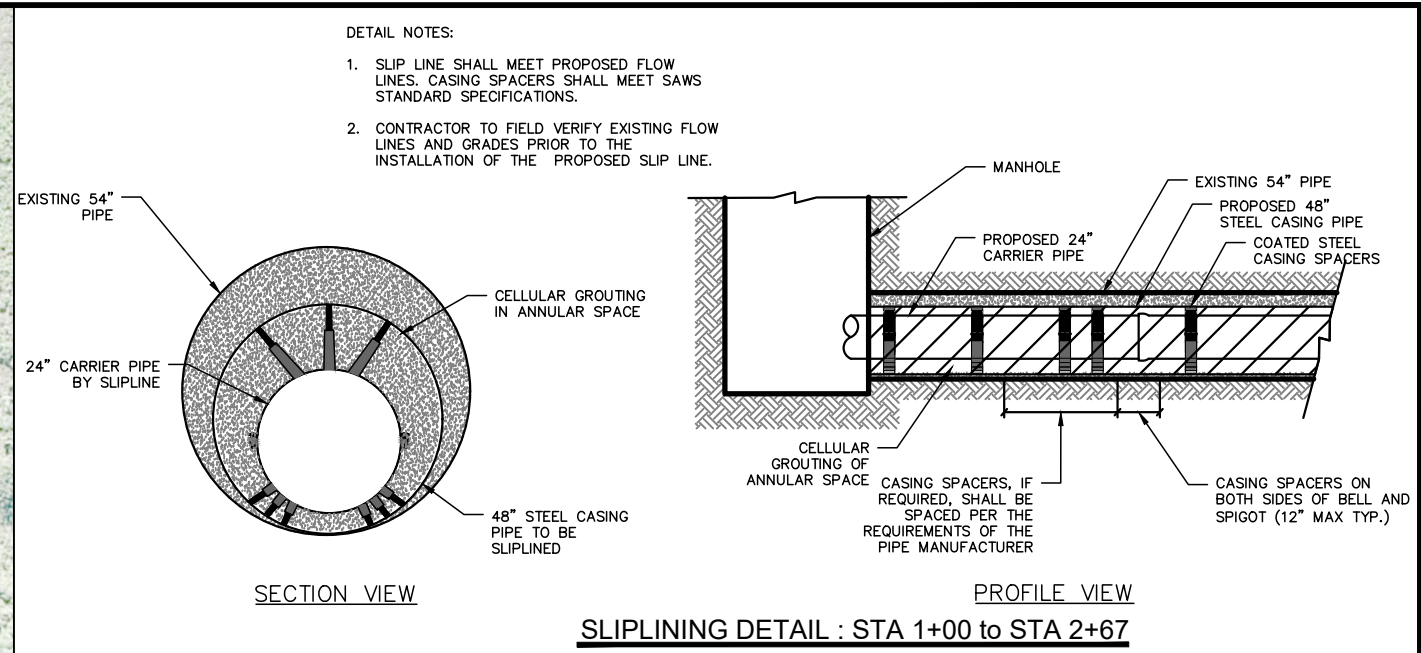
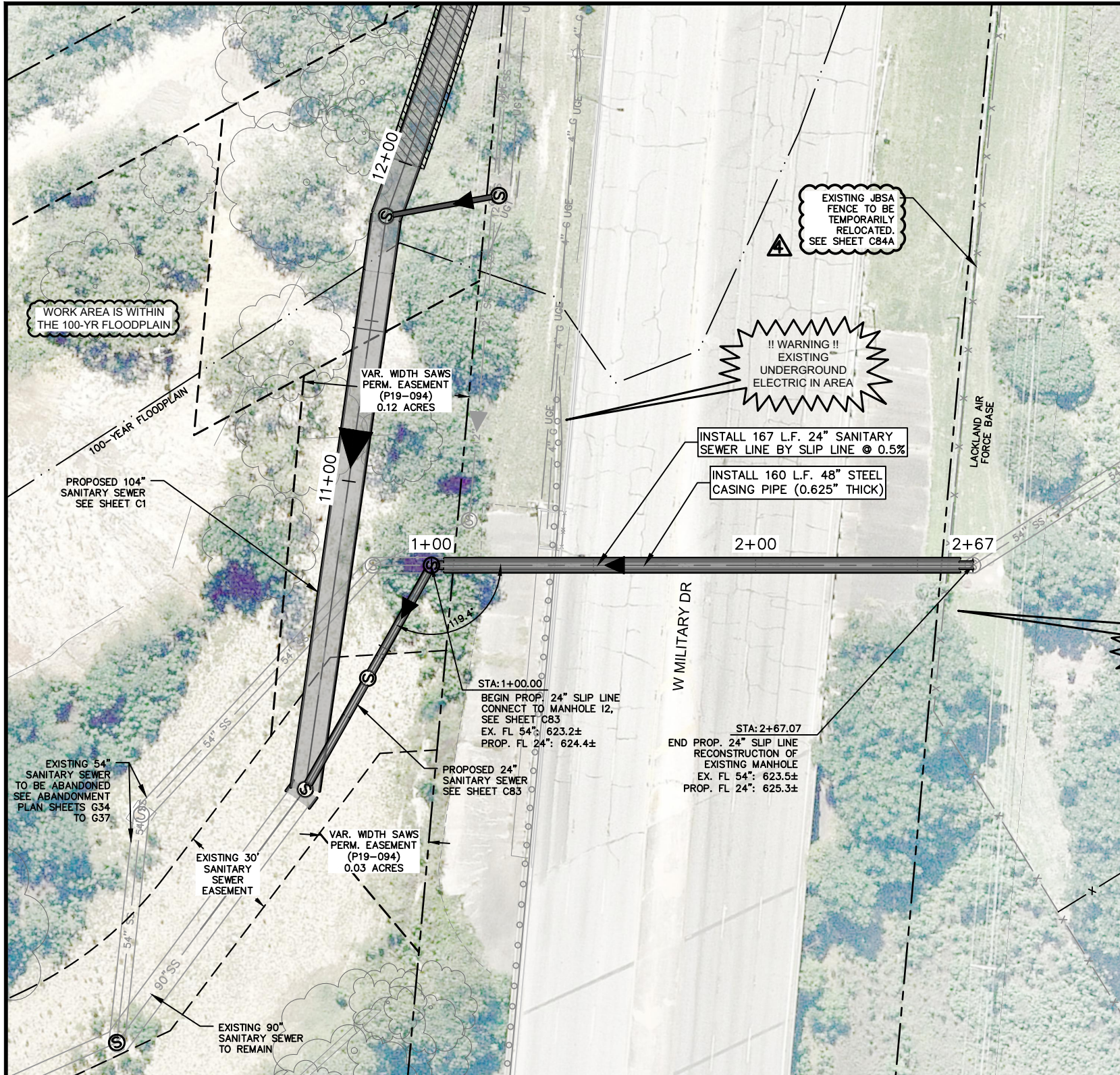
3/18/2020

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No.	Revision	By	Date
▲	ADDENDUM NO. 1	JAF	3/6/2020
▲	ADDENDUM NO. 4	JAF	3/18/2020

**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**  
104-INCH SAN. SEWER  
PLAN & PROFILE  
STA. 273+00 TO STA.  
273+64.74

DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. C67
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		



- DETAIL NOTES:
1. SLIP LINE SHALL MEET PROPOSED FLOW LINES. CASING SPACERS SHALL MEET SAWS STANDARD SPECIFICATIONS.
  2. CONTRACTOR TO FIELD VERIFY EXISTING FLOW LINES AND GRADES PRIOR TO THE INSTALLATION OF THE PROPOSED SLIP LINE.

!! WARNING !!  
EXISTING OVERHEAD  
ELECTRIC IN AREA

- NOTES:
1. EXISTING 54" PIPE TO BE SLIPLINED WITH PROPOSED 48" STEEL CASING DUE TO EXISTING CONDITIONS OF 54" SEWER. PROPOSED 48" STEEL CASING SHALL BE SLIPLINED WITH 24" CARRIER PIPE TO CONVEY FLOW FROM LACKLAND JOINT AIR FORCE BASE.
  2. SEE SLIPLINING DETAIL ON THIS SHEET FOR INSTALLATION METHODS.
  3. CONTRACTOR SHALL PERFORM SLIPLINE OF THE EXISTING 54" WITH 48" STEEL CASING PIPE IN SUCH A MANNER AS TO NOT IMPACT ROADWAY EMBEDMENT.
  4. CARRIER PIPE SHALL BE SUPPORTED AND RESTRAINED FROM FLOATING THROUGHOUT THE ENTIRE LENGTH BETWEEN MANHOLES PRIOR TO THE INSTALLATION OF GROUT.
  5. CONTRACTOR SHALL SUPPORT THE SLIP LINE PIPE AS REQUIRED TO MAINTAIN CONSTANT GRADE BETWEEN MANHOLES, AS STATED IN THE PLANS.
  6. CONTRACTOR SHALL SUBMIT DRAWINGS SHOWING HOW THE PROPOSED SLIP LINES WILL BE INSTALLED, SUPPORTED, AND GROUTED.
  7. CONTRACTOR SHALL VERIFY INVERT ELEVATIONS OF EXISTING 54-INCH PIPE ONCE MOST OR ALL FLOWS HAVE BEEN TRANSFERRED AND NOTIFY THE ENGINEER.
  8. JBSA FENCE RELOCATION MUST BE COORDINATED WITH JBSA. REFER TO SPECIAL CONDITIONS FOR COORDINATION REQUIREMENTS.
  9. PAY ITEM "REMOVE AND RELOCATE JBSA PERIMETER FENCE" INCLUDES TEMPORARY RELOCATION AND RETURN TO PRE-EXISTING LOCATION AND CONDITION.
  10. CONTRACTOR TO MAINTAIN SECURE FENCING AT ALL TIMES.

LEGEND

PROFILE VIEW:  
1" = 30' VERTICAL

PROPOSED SANITARY SEWER LINE	
PROPOSED TUNNEL	
EXISTING SANITARY SEWER LINE	
EXISTING WATER LINE	
EXISTING GAS LINE	
PROPERTY LINE	
PROPOSED FENCE LINE	
EFFECTIVE 100-YR FLOOD PLAIN	
EDGE OF ASPHALT	
EXISTING EASEMENT LINE	
PROPOSED EASEMENT LINE	
EXISTING OVERHEAD ELECTRIC LINE & POLE	
EXISTING WATER METER	
EXISTING FIRE HYDRANT	
DIRECTION OF FLOW	

3/18/2020

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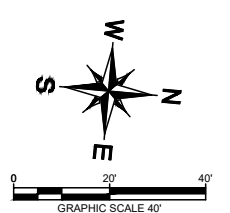
No.	Revision	By	Date
▲	ADDENDUM NO. 4	JAF	3/18/2020

**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

**24-INCH SANITARY SEWER  
SLIP LINE**

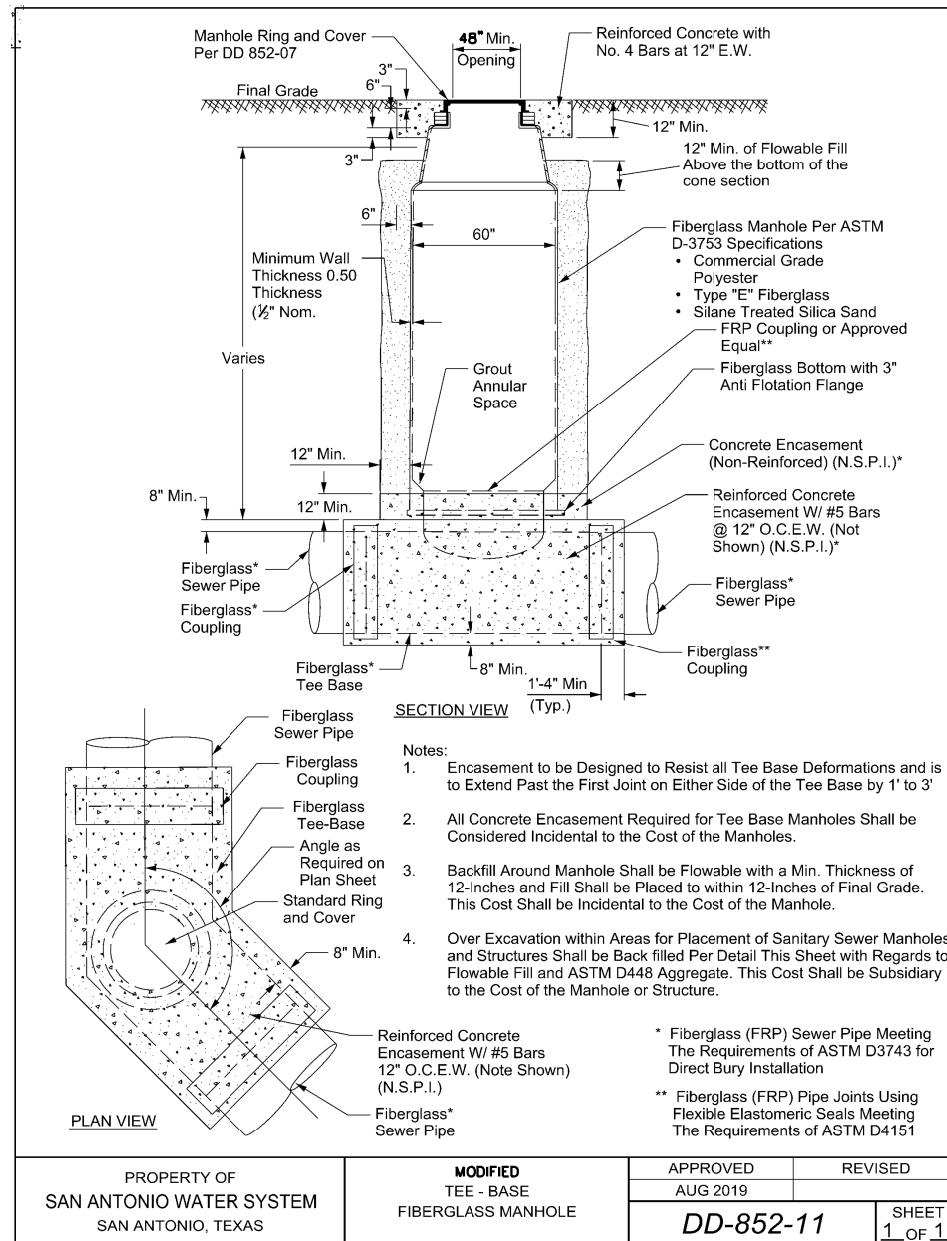
DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. <b>C84</b>
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		

ITEM NO.	DESCRIPTION	UNIT	QUANTITY
103.4	REMOVE MISCELLANEOUS CONCRETE	SF	13
855	RECONSTRUCTION OF EXISTING MANHOLES	EA	1
02610	STEEL CASING - (48-INCH)(0.625-INCH THICK)	LF	167
1100	SLIP-LINING SANITARY SEWERS(SLIPLINE 48" STEEL CASING W/ 24" (10'-14" DEPTH)	LF	167
1100	SLIP-LINING SANITARY SEWERS(SLIPLINE EX. 54" W/ 48" STEEL CASING)(10'-14" DEPTH)	LF	160

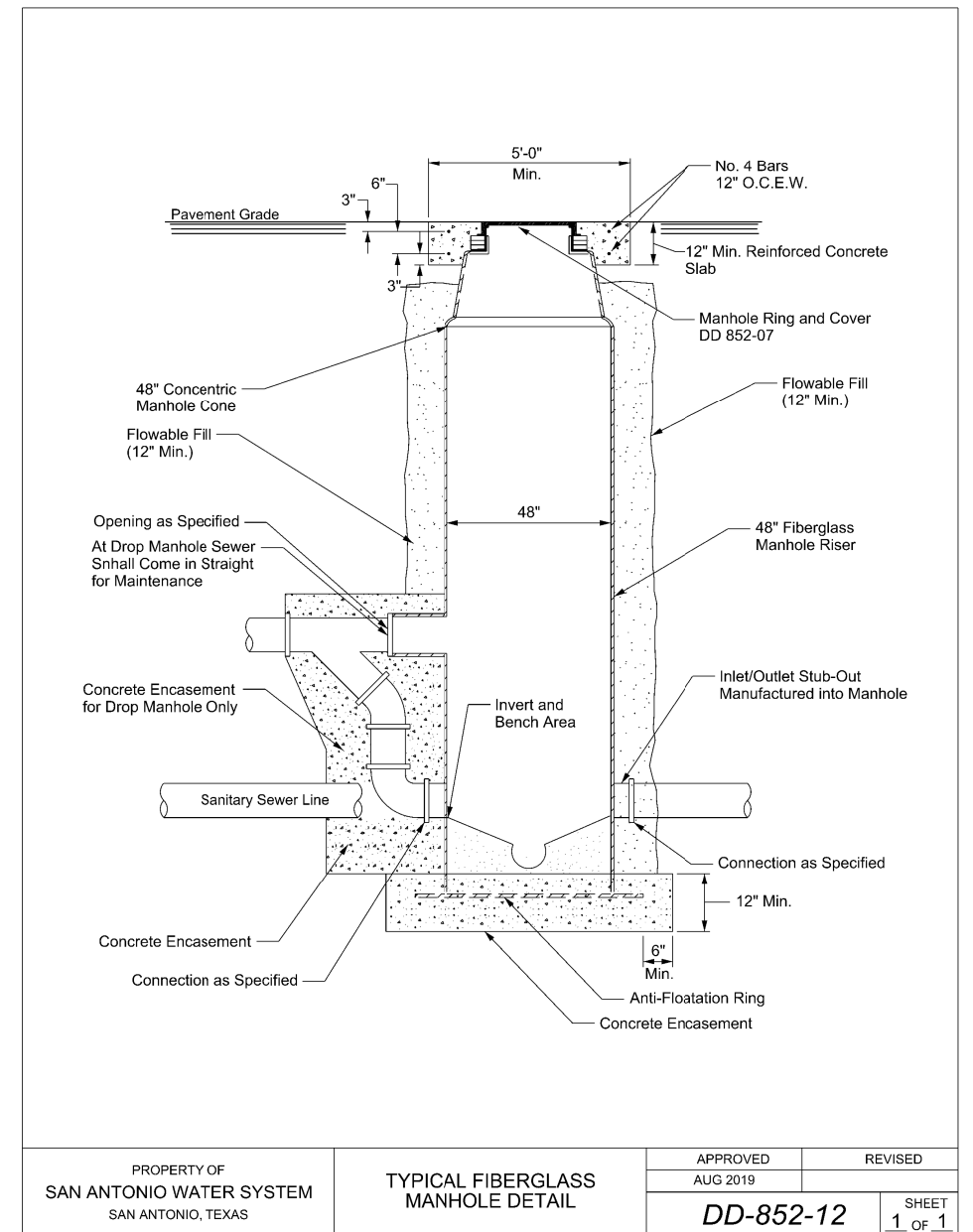


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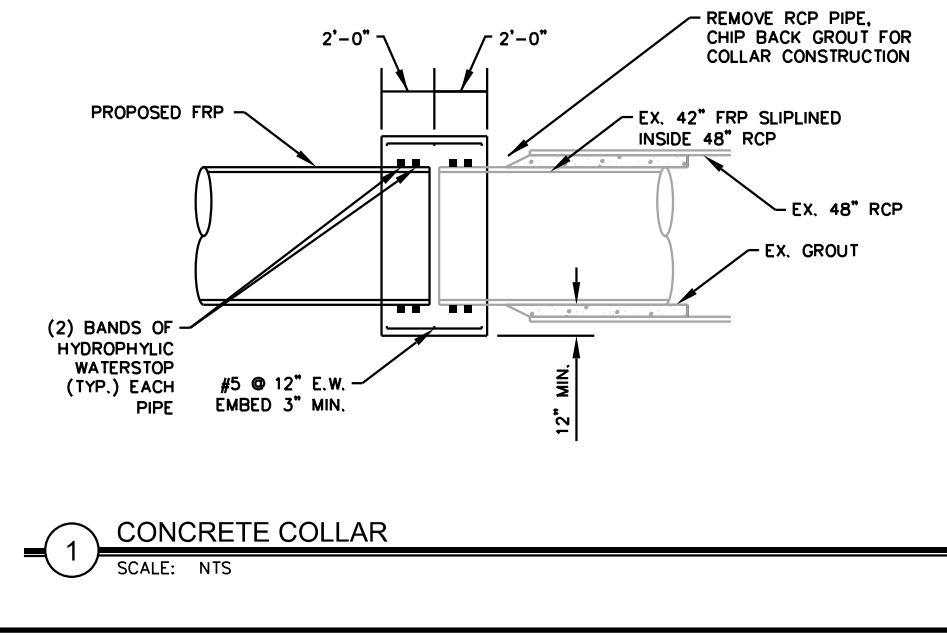




PROPERTY OF SAN ANTONIO WATER SYSTEM SAN ANTONIO, TEXAS	MODIFIED TEE - BASE FIBERGLASS MANHOLE	APPROVED	REVISED
		AUG 2019	
		<b>DD-852-11</b>	SHEET 1 OF 1



PROPERTY OF SAN ANTONIO WATER SYSTEM SAN ANTONIO, TEXAS	TYPICAL FIBERGLASS MANHOLE DETAIL	APPROVED	REVISED
		AUG 2019	
		<b>DD-852-12</b>	SHEET 1 OF 1



2/17/2020

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No.	Revision	By	Date
4	ADDENDUM NO. 4	CB	3/17/2020

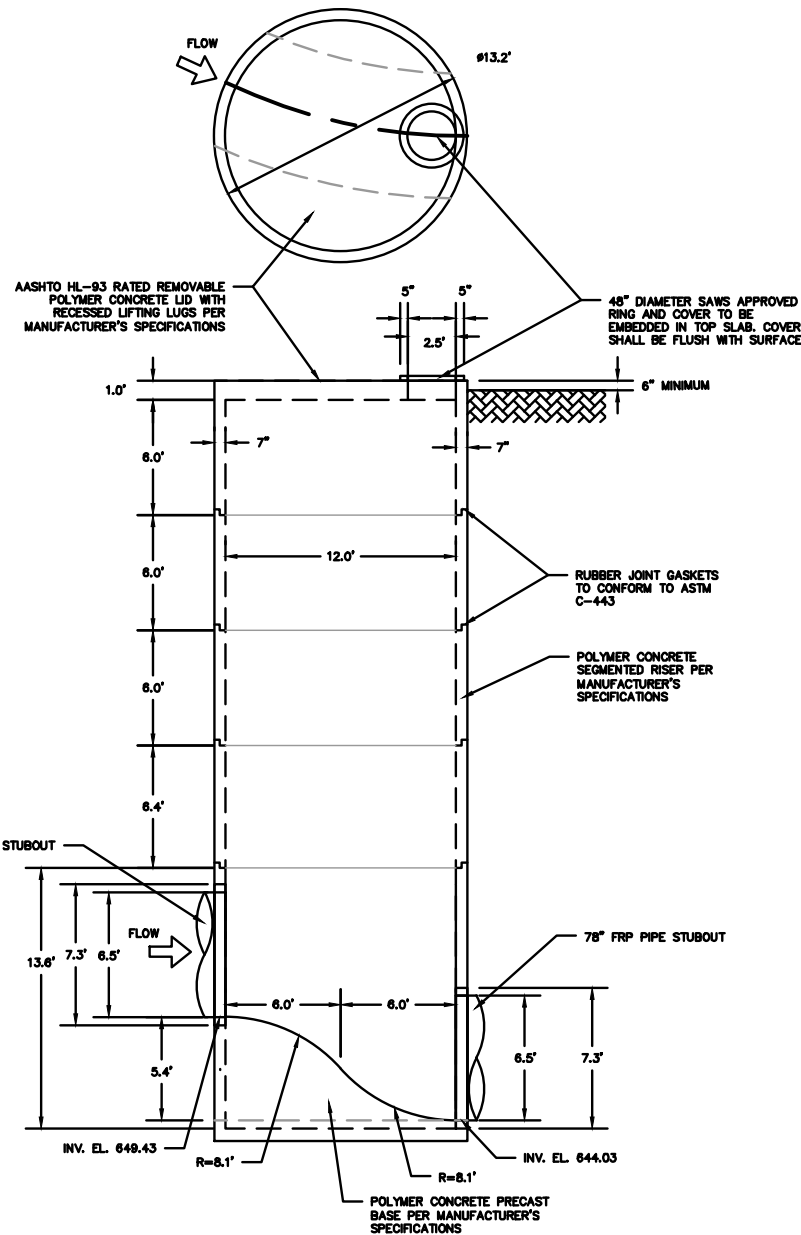
SAN ANTONIO  
WATER  
SYSTEM

**W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN**

SHEET  
**SEWER GENERAL DETAILS  
(SHEET 1 OF 4)**

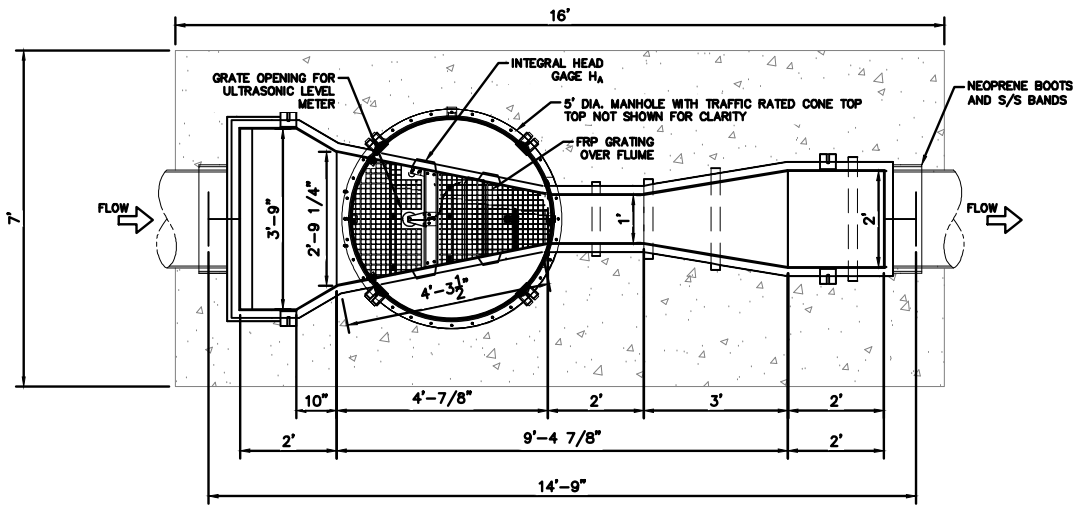
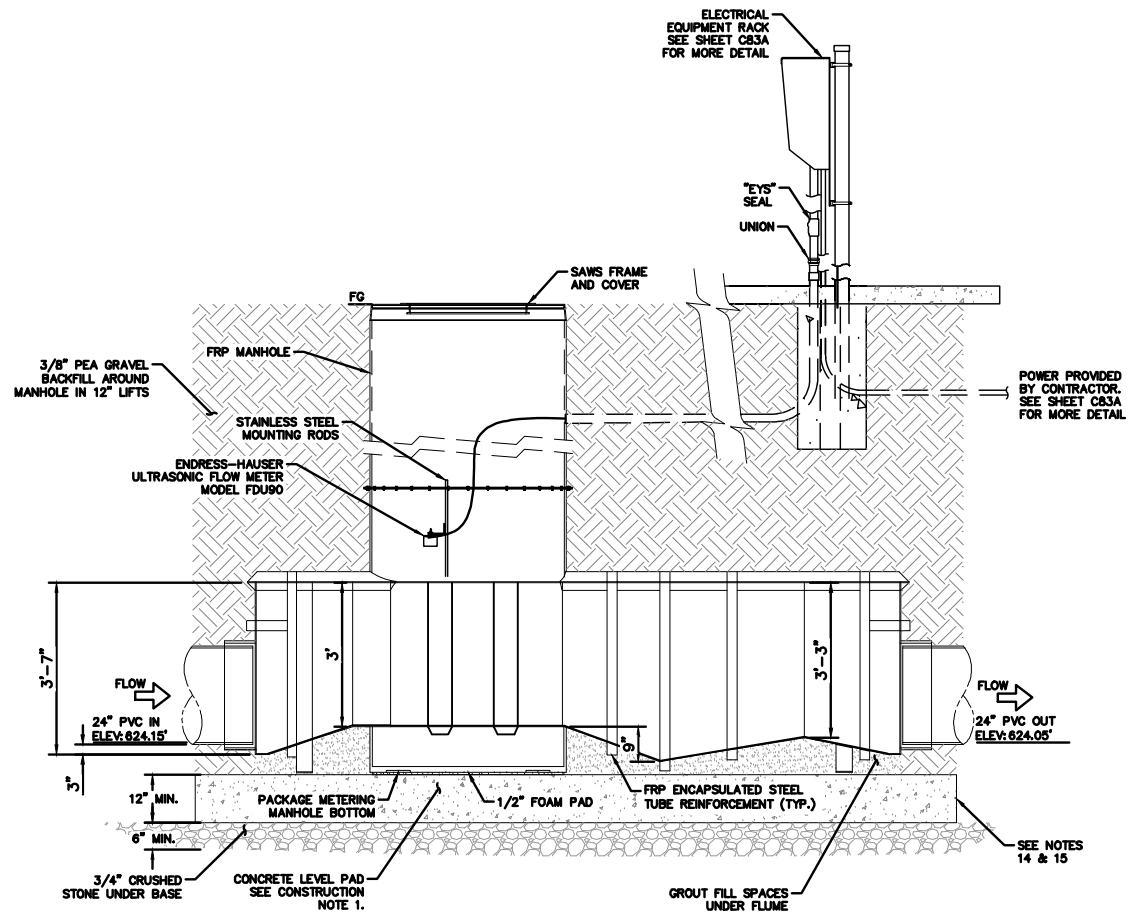
DATE: FEBRUARY 2020	SAWS PROJECT NO.	SHEET NO. <b>C86</b>
DESIGN: KFA	19-4519	
DRAWN: KFA	KHA PROJECT NO.	
CHECKED: KFA	068665052	

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**1** 12-FOOT DIAMETER POLYMER CONCRETE DROP MANHOLE  
SCALE: NTS

- NOTES:**
- POLYMER CONCRETE MANHOLE SHALL BE DESIGNED BY POLYMER CONCRETE MANUFACTURER PER SPECIAL SPECIFICATION 02600.



**2** PACKAGED METERING MANHOLE  
SCALE: NTS

- NOTES:**
- MATERIAL SHALL BE FRP (FIBERGLASS REINFORCED PLASTIC).
  - NEOPRENE BOOTS SHALL BE SECURED WITH STAINLESS STEEL BANDS.
  - MINIMUM GLASS CONTENT SHALL BE 30%, EXCLUSIVE OF RESIN RICH SURFACES.
  - MANHOLE BARREL THICKNESS SHALL BE A MINIMUM 1/2" FRP THICK.
  - THE HEAD GAGE (CENTIMETERS & HUNDREDTHS OF A FOOT) IS MOLDED INTO THE SIDE OF THE FLUME.
  - ALL BOLTS, NUTS AND WASHERS ARE TYPE 304 STAINLESS STEEL.
  - STIFFENERS ACROSS TOP OF FLUME SHALL BE 1/4"x2"x2" FRP ANGLES.
  - POLYESTER RESIN: STYPOL C1-12-0022 POLYESTER
  - CATALYST: CADOX M-50a VR
  - CONTRACTOR SHALL ENSURE THAT CONCRETE PAD IS COMPLETELY LEVEL AND INSTALLED PER SPECIFICATION 11310.
  - THE PARSHALL FLUME SHALL BE PARALLEL WITH THE BOTTOM OF THE METER STATION ± 1/16".
  - METER STATION SHALL BE CONNECTED TO THE SANITARY SEWER LINES WITH A FERNCO TYPE COUPLING USING STAINLESS STEEL BANDS.
  - METER STATION INTERIOR SHALL BE COATED WITH WHITE GEL-COAT. THE EXTERIOR SHALL HAVE AN ULTRAVIOLET PROTECTIVE COATING.
  - 5' INSIDE DIAMETER FIBERGLASS METERING MANHOLE AS SHOWN. MANHOLE TOP SHALL BE H-20 TRAFFIC LOADING RATED PER PACKAGED METERING MANHOLE MANUFACTURER AND SHALL INCLUDE STANDARD SJRA FRAME AND COVER. THE PACKAGE METERING MANHOLE, INTEGRATED PARSHALL FLUME, AND ASSOCIATED LEVEL CONCRETE PAD SHALL BE DESIGNED FOR ALL LOADS, INCLUDING SURCHARGE PRESSURES FROM ADJACENT STRUCTURES. SHOP DRAWINGS SHALL INCLUDE WRITTEN CONFIRMATION THAT THE PACKAGE METERING MANHOLE, INTEGRATED PARSHALL FLUME, AND ASSOCIATED LEVEL CONCRETE PAD DESIGNS ACCOUNT FOR THESE LOADS AND ARE SIGNED AND SEALED BY A PROFESSIONAL ENGINEER LICENSED IN THE STATE OF TEXAS.
  - THE PACKAGE METERING MANHOLE, INTEGRATED PARSHALL FLUME, AND ASSOCIATED LEVEL CONCRETE PAD SHALL BE DESIGNED TO RESIST A BUOYANCY FORCE ASSUMING THE WATER TABLE IS AT THE SURFACE WHILE MAINTAINING A 1.5 FACTOR OF SAFETY.
  - METER STATION SHALL HAVE A MINIMUM OF FOUR LIFTING EYES CAST INTO THE STRUCTURE. EACH SHALL BE CAPABLE OF SUPPORTING THE WEIGHT OF THE STRUCTURE.
  - MINIMUM FRP WALL THICKNESS SHALL BE 1.38".
  - BOTTOM PLATE MINIMUM THICKNESS SHALL BE 1.38".

3/18/2020

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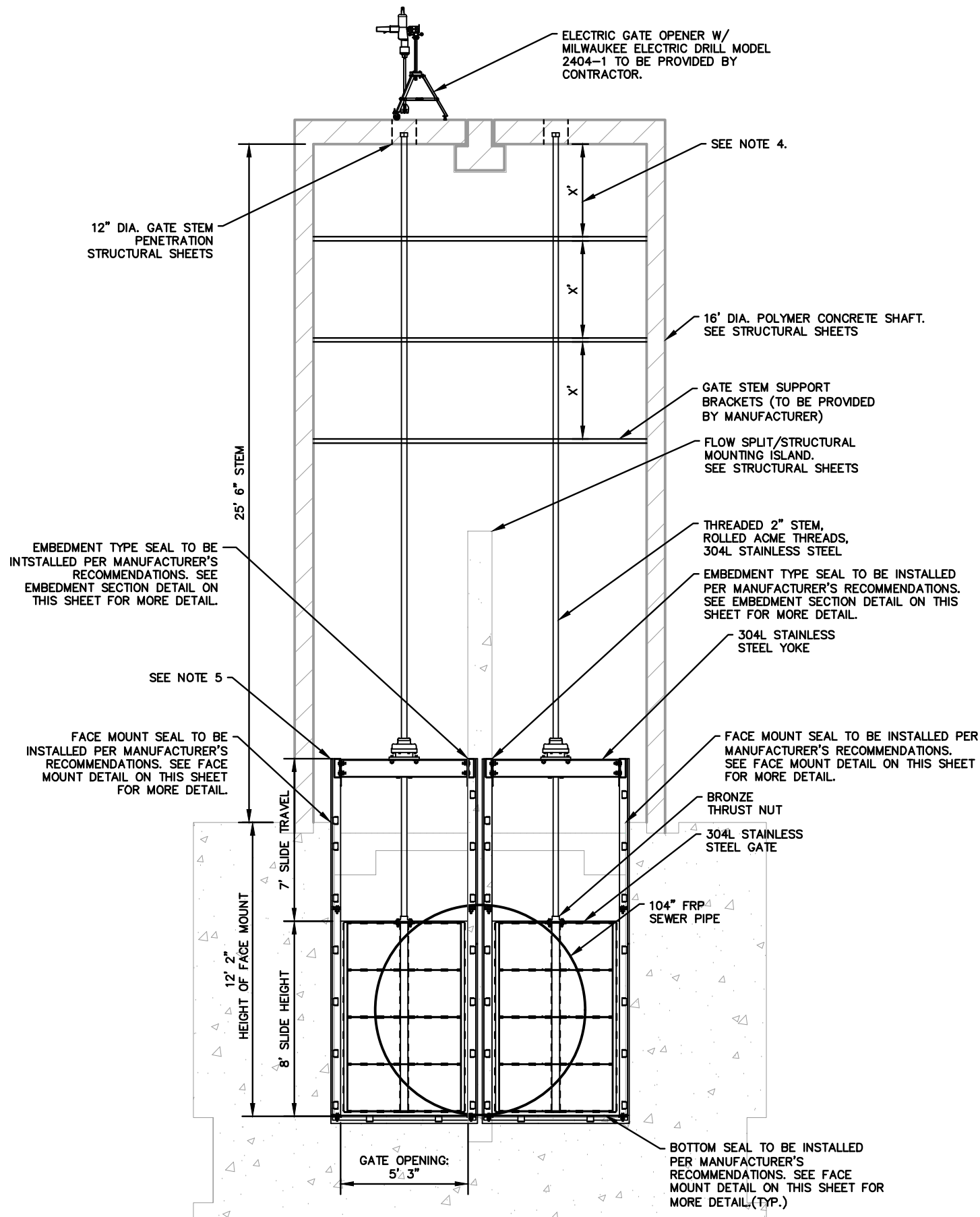
No.	Revision	By	Date
▲	ADDENDUM NO. 1	JAF	3/8/2020
▲	ADDENDUM NO. 4	JAF	3/18/2020

W-6 UPPER SEGMENT:  
HWY 90 TO SW MILITARY DR  
SEWER MAIN

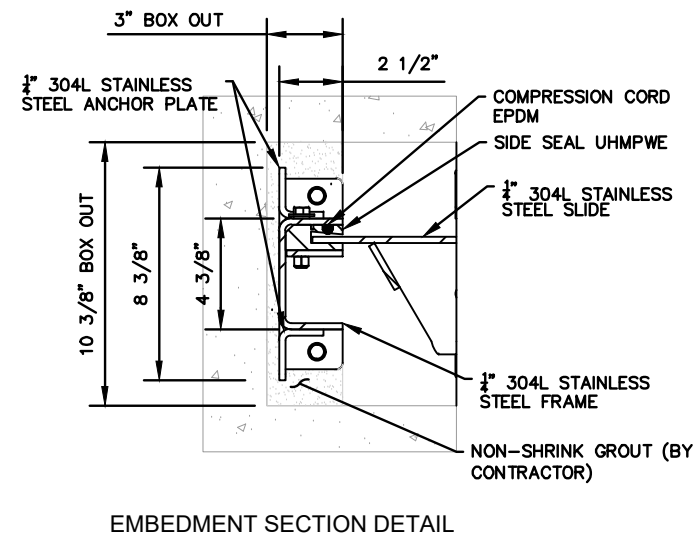
**SEWER GENERAL DETAILS**  
(SHEET 2 OF 4)

DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. <b>C86A</b>
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		

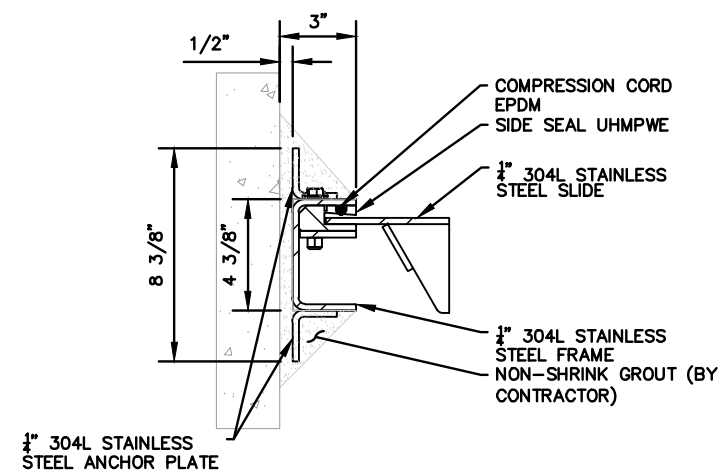
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 2/15/2020



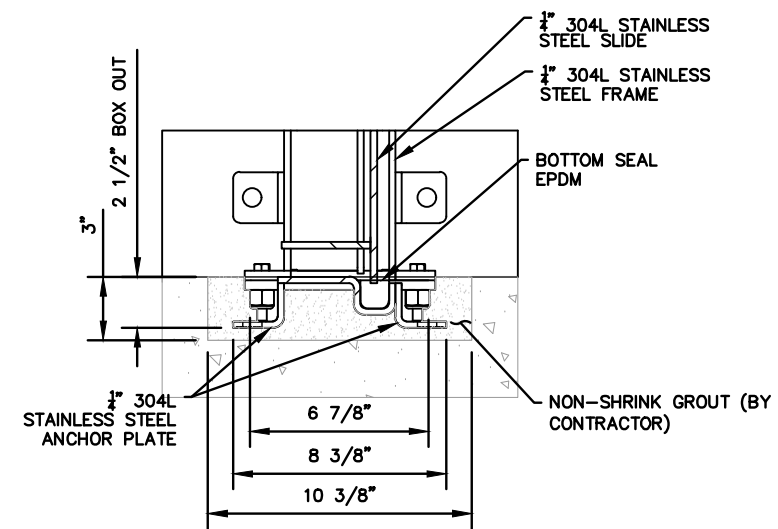
1 STAINLESS STEEL SLUICE GATE DETAIL  
SCALE: NTS



EMBEDMENT SECTION DETAIL



FACE MOUNT SECTION DETAIL



BOTTOM SEAL DETAIL

NOTES:

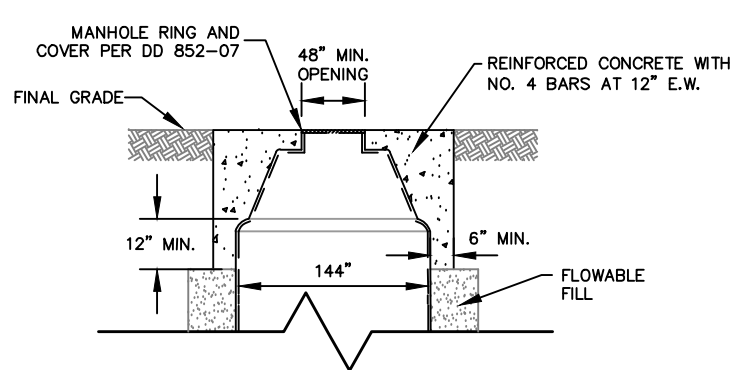
- GATE TO BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS. CONTRACTOR SHALL COORDINATE WITH MANUFACTURER PRIOR TO INSTALLATION.
- PORTABLE ELECTRIC GATE OPENER TO BE PROVIDED BY CONTRACTOR.
- TOP OF GATE STEM SHALL BE INSTALLED 3" BELOW TOP OF SLAB AND SHALL BE CENTERED ON THE 12" HANDHOLE. CONTRACTOR TO VERIFY.
- GATE MANUFACTURER TO PROVIDE STEM SUPPORTS AND RECOMMENDED INSTALL SPACES.
- SEE STRUCTURAL SHEETS S35-S43 FOR PLACEMENT OF GATE AND MOUNTING POSITION.

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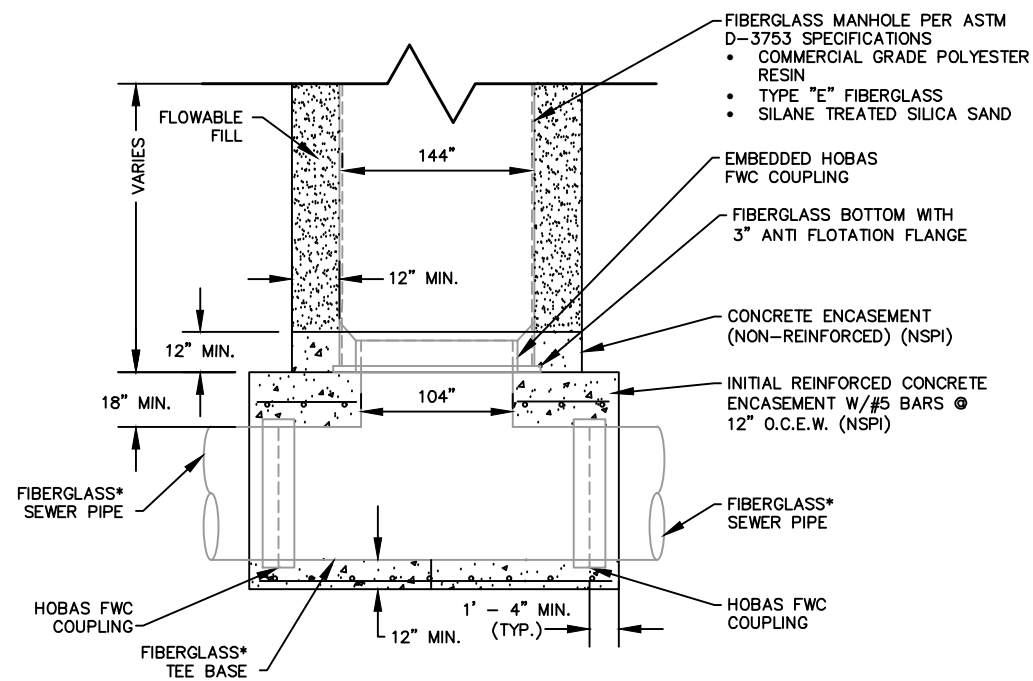
No.	Revision	By	Date
▲	ADDENDUM NO. 4	JAF	3/18/2020

	W-6 UPPER SEGMENT: HWY 90 TO SW MILITARY DR SEWER MAIN
	SEWER GENERAL DETAILS (SHEET 3 OF 4)

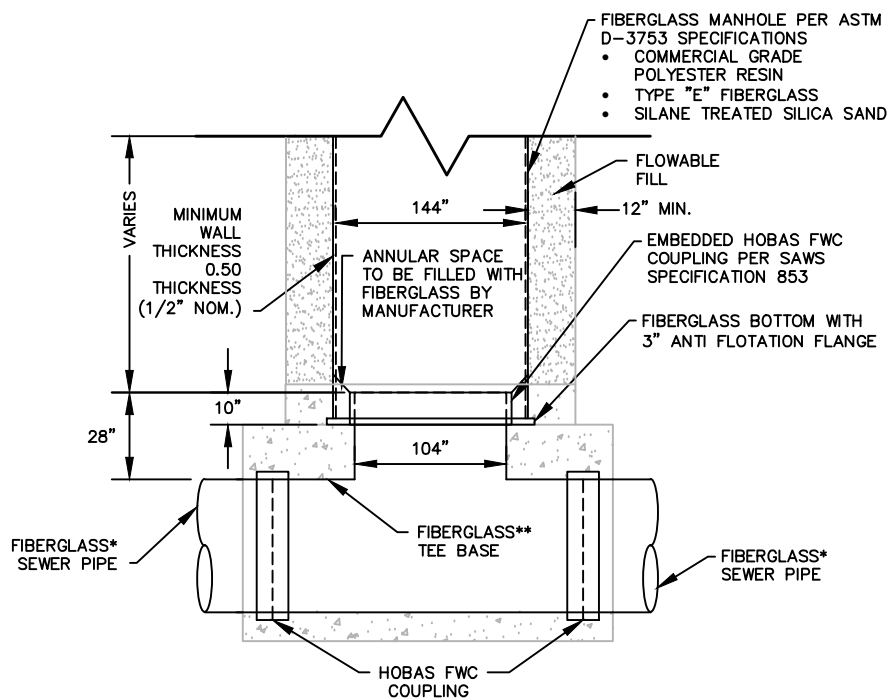
DATE: MARCH 2020	SAWS PROJECT NO. 19-4519	SHEET NO. <b>C86B</b>
DESIGN: JKN	KHA PROJECT NO. 068665052	
DRAWN: CRW		
CHECKED: JAF		



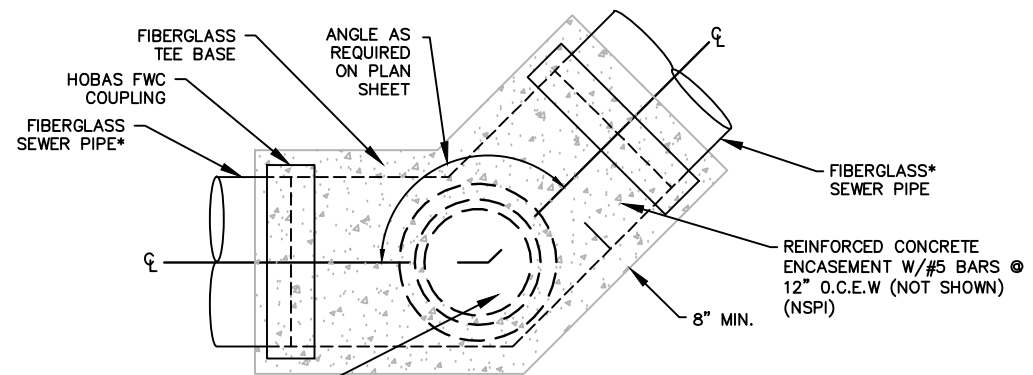
SECTION VIEW - UPPER



CONCRETE ENCASEMENT



SECTION VIEW - LOWER



PLAN VIEW

SEE SHEET S1, DETAIL B FOR COVER SEWER WATERTIGHT MANHOLE (SEE NOTE 7)

1 12-FOOT DIAMETER TEE BASE FIBERGLASS MANHOLE  
SCALE: NTS

FIBERGLASS MANHOLE PER ASTM D-3753 SPECIFICATIONS  
 • COMMERCIAL GRADE POLYESTER RESIN  
 • TYPE "E" FIBERGLASS  
 • SILANE TREATED SILICA SAND

FIBERGLASS MANHOLE PER ASTM D-3753 SPECIFICATIONS  
 • COMMERCIAL GRADE POLYESTER RESIN  
 • TYPE "E" FIBERGLASS  
 • SILANE TREATED SILICA SAND

NOTES:

1. ENCASEMENT TO BE DESIGNED TO RESIST ALL TEE-BASE DEFORMATION AND IS TO EXTEND PAST THE FIRST JOINT ON EITHER SIDE OF THE TEE BASE BY 1' TO 3'.
2. ALL CONCRETE ENCASEMENT REQUIRED FOR TEE BASE MANHOLES SHALL BE CONSIDERED INCIDENTAL TO THE COST OF THE MANHOLES.
3. BACKFILL AROUND MANHOLE SHALL BE FLOWABLE WITH A MIN. THICKNESS OF 12-INCHES AND FILL SHALL BE PLACED TO WITHIN 12-INCHES OF FINAL GRADE. THIS COST SHALL BE INCIDENTAL TO THE COST OF THE MANHOLE.
4. OVER EXCAVATION WITHIN AREAS FOR PLACEMENT OF SANITARY SEWER MANHOLES AND STRUCTURES SHALL BE BACK FILLED PER DETAIL THIS SHEET WITH REGARDS TO FLOWABLE FILL AND ASTM D448 AGGREGATE. THIS COST SHALL BE SUBSIDIARY TO THE COST OF THE MANHOLE OR STRUCTURE.

\* FIBERGLASS (FRP) SEWER PIPE MEETING THE REQUIREMENTS OF ASTM D3262 FOR DIRECT BURY INSTALLATION

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No.	Revision	By	Date
▲	ADDENDUM NO. 4	JAF	3/18/2020

	W-6 UPPER SEGMENT: HWY 90 TO SW MILITARY DR SEWER MAIN
	SEWER GENERAL DETAILS (SHEET 4 OF 4)

DATE: MARCH 2020	SAWS PROJECT NO.	SHEET NO. <b>C86C</b>
DESIGN: JKN	19-4519	
DRAWN: CRW	KHA PROJECT NO.	
CHECKED: JAF	068665052	